IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

APPLIED MYCOLOGY

VOL. II NOVEMBER 1923

HUMPHREY (C. J.). **Diseases of ornamental and forest trees.**—*Ann. Rept. Wisconsin State Hort. Soc.*, lii, pp. 92–99, 3 figs., 1922.

In the case of forest and ornamental trees, leaf-inhabiting fungi are not of such importance as they are in fruit trees. A conspicuous representative is the tar spot of maple (*Rhytisma acerinum*) which may be controlled by the burning of the fallen leaves in autumn in order to prevent infection by ascospores in the spring. Chestnut bark disease [*Endothia parasitica*], which has practically destroyed the native chestnut stands north of North Carolina, can be combated only by the breeding of resistant varieties.

Wisconsin, however, is more vitally affected by the serious white elm disease, caused by *Sphaeropsis ulmicola*. The most striking symptom of the disease is the sudden death of certain smaller branches scattered throughout the crown, due to girdling. Below the girdle water-sprouts very often develop. Over the attacked areas the smooth bark becomes somewhat sunken and loses the normal healthy green appearance. From these girdled regions the fungus grows into adjacent healthy tissues so that the whole crown may in time become involved. Every possible effort should be made to eradicate this epidemic and destructive disease. Infected limbs should be excised and burnt, while ample watering and fertilization also assist in the recovery of diseased trees. Infected seedlings should be destroyed.

Near Madison *Armillaria mellea* is most commonly found on scarlet and black oaks, and sometimes on white and bur oaks. In the fruit-growing regions it occurs on various stone fruits, especially the cherry, while on the Pacific coast it is reported to cause a serious disease of small fruits. The main line of control should be the prevention of the spread of the infection. The isolation of

infected areas by trenching is useful only in the case of definitely localized infection.

For the treatment of wounds shellac is recommended for small wounds and for larger ones a 50 : 50 mixture of coal-tar creosote and asphaltum. In the case of such delicate trees as the peach, cherry, plum, magnolia, and tulip a 25 : 75 mixture of coal-tar creosote and asphaltum may be substituted for the above. The cut bark and adjoining wood should be painted with shellac before the creosote mixture is applied.

The author concludes with a brief discussion on the care of trees in the public parks and highways and urges the necessity of municipal control for the prevention of injury and disease.

KÖNIG. **Ueber Rotfäulebestände und deren Behandlung.** [Stands infected with red rot and their treatment.]—*Tharandter forstl. Jahrb.*, lxxiv, 2, pp. 63-74, 1923.

During his administration of the Lossnitz [Saxony] crown lands, the author observed numerous cases of red rot of fir trees cultivated, for the most part, on what was formerly arable land. Resin was exuded from the trunks of affected trees and the fructifications of *Trametes radiciperda* [*Fomes annosus*] were frequently observed. The entire root system of fallen trees was often found to be decayed, the weaker strands being severed. As a rule the base of the trunk was only fit for firewood. The affected trees sometimes formed a circle round groups of completely healthy firs, which became infected one by one. The stiff clay soil of the Lossnitz forests also favoured the disease by preventing the penetration of the roots, which were frequently severed in one or more places, thereby affording easy access to the spores of the fungus.

The presence of smoke gas is another frequent source of trouble, the acids impeding the decomposition of the humus in the soil. The local practice of planting the seedlings in groups, instead of singly, also increased the danger of infection by weakening the individual development of the trees. The use of fir trees on the borders of plantations, where they are exposed to the full force of the wind, is another fault of cultivation. They should be replaced on the north, east, and west by shade trees, if the soil is deep enough, or by larches or white pines in shallow soil. Gaps in the interior of the stand should be filled with hornbeam, beech, or ash trees.

BOYCE (J. S.). **The deterioration of felled western Yellow Pine on insect-control projects.**—*U.S. Dept. Agric. Bull.* 1140, 7 pp., 1923.

The losses from decay in western yellow pine (*Pinus ponderosa*) felled and barked in order to control insect epidemics, in the Klamath Lake region of southern Oregon are relatively slight (13 to 18 per cent.) during the first year. In the second year, however, they are so heavy (63 to 76 per cent.) that the cut trees must be regarded as lost if they cannot be utilized within twelve months. Among the fungi causing decay were *Polyporus anceps*, *Lenzites saepiaria*, and *Fomes pinicola*.

SCHELLENBERG (H. C.). **Die Empfänglichkeit der Ribesarten für den Rost der Weymouthkiefer.** [The susceptibility of *Ribes* species to White Pine blister rust.]—*Schweiz. Zeitschr. für Forstwesen*, lxxiv, 1–2, pp. 25–50, 1923.

Since the writer first detected blister rust (*Cronartium ribicola*) on *Pinus cembra* in the Engadine, he has collected data on the comparative susceptibility to the disease of the various species of *Ribes*. Taking 10 to represent the highest degree of susceptibility and 0 as immunity, the species may be classified as follows:—*Ribes nigrum*, 10; *R. petraeum*, 9–10; *R. alpinum*, 7–9; *R. uva crispa*, 6–8; *R. grossularia*, 2–8; *R. aureum*, 5–7; *R. rubrum*, 2–4.

R. nigrum appears to exhibit no varietal differences in the degree of attack, while *R. grossularia*, formerly supposed to be immune, varies considerably in susceptibility. Of two bushes in the author's garden one bearing pink berries was regularly and severely infected, while on a yellow variety the attacks were extremely rare and negligible in extent. Other similar instances have also been observed. The author's investigations do not confirm Klebahn's theory that the stock in grafted bushes exerts an influence on the susceptibility of the scion.

R. rubrum appears to be exceedingly resistant to the disease even in the immediate vicinity of heavily infected black currants. This statement applies primarily to the Dutch red currant, which is extensively cultivated in Switzerland. The Versailles and the white and striped varieties are also resistant, but slightly less so than the Dutch.

As regards the ornamental currant species, both *R. sanguineum* and *R. gordonianum* are very susceptible, *R. aureum*, which is always used as a stock for espalier currants or gooseberries, is less susceptible than *R. sanguineum* and *R. gordonianum* but more so than *R. rubrum*.

The susceptibility of the wild species, *R. petraeum* and *R. alpinum* is of no great importance, since they occur only in the Alpine regions where the pine is not cultivated. Much more serious is the liability to the disease of *R. uva crispa*, which is constantly found in localities where the white pine is grown on a large scale, and which must undoubtedly be regarded as the natural intermediate host in cases where the blister rust occurs on white pines at a distance from cultivated *Ribes*.

In view of the impossibility of eradicating the wild currant from the forests in which it has once gained a foothold, the cultivation of the white pine in its neighbourhood cannot be recommended.

HOTSON (J. W.). **Blister rust—a menace to prosperity.**—*Univ. of Washington Forest Club Quarterly*, i, 2, pp. 18–25, 3 figs., 1922.

White pine blister rust (*Cronartium ribicola*), the symptoms, life-history, and distribution of which are described, has been definitely located in four different parts of Washington. An account is given of the legislative measures formulated at the White Pine Blister Rust Conference in December 1921, and an appeal made for general co-operation to prevent the further spread of the disease in the States of Washington, Oregon, California, Idaho, and Montana.

It is estimated that there are a billion feet of white pine in the commercial areas of north-eastern Washington and 600,000,000 feet in Oregon.

WEIR (J. R.). **The genus Polystictus and decay of living trees.**—*Phytopath.*, xiii, 4, pp. 184–186, 1923.

In this paper eleven species of *Polystictus* (*P. abietinus, P. biformis, P. cinnabarinus, P. conchifer, P. floridanus, P. hirsutus, P. lacteus, P. pergamenus, P. pinsitus, P. versicolor, P. zonatus*) are listed as causing decay of trees. Notes regarding the parasitic action of each species are given, usually showing that the decay makes slow progress in otherwise healthy trees. The rots are usually white or yellowish or of a slight reddish tinge in the case of *P. cinnabarinus*, but are not specially differentiated. These fungi are primarily scavengers of the forest, destroying timber débris, but may become important in the decay of useful material left too long in the woods.

MALAQUIN (A.). **La maladie des Ormes.** [The disease of Elms.]—*Renaissance agric.*, iv, pp. 91–94, 1923.

This disease of elms, now reported from the neighbourhood of Lille, is evidently the same as that already described in Holland and Picardy [see this *Review*, i, p. 334, and ii, p. 431]. The author believes it to be due to the attacks of *Scolytus* beetles, but states that it has also been attributed to the injurious effects of gas and to the drought of 1921.

PETERS. **Die Kräuselkrankheit der Rüben.** [The curl disease of Beets.]—*Deutsche landw. Presse*, l, 13, p. 117, 3 figs., 1923.

Sugar and fodder beets, mangolds, and other cultivated varieties of *Beta vulgaris* are liable to occasional attacks of downy mildew (*Peronospora schachtii*). The first symptom of the disease is usually a marked retardation of the growth of the heart in early summer. The heart in such cases consists of small, discoloured, very crumpled leaves with short petioles, encircled by fully developed leaves with petioles of the normal length. The young heart leaves are completely diseased, the older ones remaining healthy at the tip. The under side of the diseased leaves is covered with the whitish, subsequently grey, fructifications of the fungus. The dissemination of the spores (the average dimensions of which are 24 by 20 μ) is presumably effected by the wind, possibly also by insects. The incubation period seems to be very short; in any case, continuous new infections have been observed during the growing season in cool, damp weather. The disease is rapidly arrested, however, even by a brief spell of dry, warm weather, and the decayed heart leaves are then replaced by small, narrow ones. In this stage of the disease the affected plants resemble those suffering from heart rot [attributed by some to *Phoma betae*, by others believed to be a physiological disorder] except for the absence of the dry patches of decay on the sides of the root. Early infections generally cause some reduction in yield and in the sugar content of the beet owing to the temporary disturbance of metabolism; on the other hand, the frequent cases of reinfection in the autumn are of little practical

significance. Tests carried out at the Uckermark Sugar Factory at Strasburg showed a reduction in the sugar content of diseased beets of only 0·2 to 0·4 per cent.

Gäumann has shown that the species of *Peronospora* are usually very highly specialized in their parasitism, rarely affecting more than one host plant. It is therefore very improbable that the mildew of beet can be transmitted from or to other members of the Chenopodiaceae. The conidia of the fungus remain viable only for a very brief period, and the formation of resting spores, in Germany at any rate, is very uncommon. The mycelium of *P. schachtii*, however, can overwinter in the tissues of infected beet roots and infect the new shoots. When beet for seed bearing is planted out the diseased shoots from the infected roots can be recognized by their stunted growth, curled or crumpled leaves, and copious spore production. The common practice of locating the seed-beds next to fields planted with seed bearers ('stecklings') favours the spread of the disease and should be discontinued. All the infected portions of seedlings and seed bearers should be removed and buried. At harvest it is advisable to discard all suspected plants from use as seed bearers. The fields in which the latter are planted should be situated in such a position that the prevailing winds do not pass over them before reaching the seed-beds. By the adoption of these simple measures complete control of the disease is stated to be ensured.

TAKIMOTO (K.). **On the vitality of Cercospora beticola.**—*Ann. Phytopath. Soc. Japan*, i, 5, pp. 43–44, 1923. [In Japanese, with English summary.]

Spores of *Cercospora beticola* kept in a dry condition at the laboratory remained viable for 16 months, while those on the seeds were capable of germination until the sowing season, at the end of April, of the following year. The spores on diseased leaves kept in cellars were not able to germinate at the beginning of May, but sclerotial bodies or mycelia in the tissues were viable throughout the winter. The results of field experiments showed that sclerotial bodies and mycelia were frequently viable after the spores had lost their germinating power. In the laboratory the spores of diseased leaves mixed with wet soil died in three to four weeks.

GARDNER (M. W.) & KENDRICK (J. B.). **Bacterial spot of Cowpea.**—*Science*, N. S., lvii, 1470, p. 275, 1923.

Since 1919 a destructive bacterial disease of the cowpea (*Vigna sinensis*) has been noted in Indiana, leaves, stems, and pods being affected. On the leaves the symptoms consist of irregularly circular spots, 1 to 3 mm. in diameter, with maroon edges and buff centres. The young lesions are greasy and water soaked. On the pods the spots are also irregularly circular, 1 to 8 mm. in diameter, and maroon in colour, often with a depressed centre and water soaked border. Early infection may cause a constriction of the pod and stunting of the distal portion, and the seeds under the pod lesions may be stunted, shrivelled, or discoloured. Dark red, elliptical to linear, sunken lesions are formed on the petioles and

stems. In addition to lesions on cotyledons, first leaves, hypocotyls, and epicotyls, localized vascular infection and partial wilting may occur among seedlings grown from diseased seed.

Numerous isolations and successful inoculations proved the disease to be due to an apparently undescribed bacterium, the diagnosis of which is as follows: *Bacterium vignae* n. sp. Cylindrical rods, rounded at ends, solitary or in pairs; individual rods, 1·5 to 2 by 0·5 μ; motile by 1 to 5 polar flagella at one or both poles; aerobic; no spores or capsules. Gram negative; staining readily with gentian violet. Superficial colonies on potato agar round, smooth, shining, raised, pulvinate, or umbonate, finely granular, often showing a concentric pattern, greyish-white in reflected light, slightly greenish fluorescent in transmitted light. Gelatine rapidly liquefied; casein digested and no acid produced in milk; nitrates not reduced; no gas with various carbohydrates and no acid except for small amount with dextrose and saccharose; starch not hydrolized. Growth and greenish pigment formation in Fermi's and Uschinsky's solutions; no growth in Cohn's solution; slow liquefaction of blood serum and Loeffler's blood serum. Growth inhibited by 5 per cent. sodium chloride. Growth in broth at +12 and −15 and at P_H 4·8. Greenish pigment formation in alkaline broth. Thermal death point 50° C.; killed by one hour's exposure to sunlight, and slowly killed by freezing in water. Rapidly killed by desiccation on glass but very resistant to desiccation on cowpea seeds. Group number 211.2232033.

The disease is seed borne and can probably be controlled by the use of seed from healthy pods.

HARTER (L. L.), LAURITZEN (J. I.), & WEIMER (J. L.). **Mottle-necrosis of Sweet Potatoes.**—*Phytopath.*, xiii, 3, pp. 145–146, 1 fig., 1923.

This disease is characterized by brown, irregularly formed and sometimes completely isolated patches of dead tissue occurring throughout the sweet potato. In mild cases there is no external symptom, but in advanced stages dead areas occur at the surface of the tuber.

The disease has been observed at digging time and is reported from various parts of the United States. So far no causal organism has been isolated, and sometimes the spots are free from mycelium. The authors are continuing their investigations on the disease.

STELL (F.). **A fungus disease of Cabbages.**—*Bull. Dept. Agric. Trinidad and Tobago*, xx, 2–4, p. 116, 1922.

The disease known as cabbage yellows, due to a species of *Fusarium* [*F. conglutinans*], has recently been reported from the San Juan district of Trinidad. The author briefly describes the symptoms and life-history of this disease and states that efforts are being made to introduce resistant varieties from the United States, the Wisconsin variety being under trial at St. Clair Experiment Station.

GRAM (E.) & ROSTRUP (SOFIE). **Oversigt over Sygdomme hos Landbrugets og Havebrugets Kulturplanter i 1922.** [Survey of the diseases of cultivated agricultural and horticultural plants in 1922.]—*Tidsskr. for Planteavl*, xxiv, 2, pp. 236–307, 2 figs., 1923. [English summary.]

The period under review (1st October 1921, to 30th September 1922) was characterized in Denmark by a dry, sunny autumn with several heavy storms, a cold and dry period in January and February, a late spring, and a cool, moist summer. The fungous diseases are classified under the following headings, many other records being given besides those enumerated below.

CEREALS. Serious attacks of stripe disease of barley (*Pleospora graminea*) occurred in various localities, especially on the susceptible Karl and Prentice varieties. Leaf spot disease of barley (*P. teres*) was very severe on Tystofte Prentice. Mildew (*Erysiphe graminis*) attacked late-sown barley on damp soil and in the vicinity of winter barley. Severe attacks of covered smut of barley (*Ustilago hordei*) on the Abed and Tystofte Prentice varieties were reported. Wheat sown at the end of September also suffered from mildew while that sown a month later was free from the disease. Bunt of wheat (*Tilletia caries*) is notably decreasing in prevalence, partly as a result of seed disinfection. Loose smut of oats (*U. avenae*) was much in evidence, and there are some indications that it is correlated with insufficient fertilization. Flag smut of rye (*Urocystis occulta*) was prevalent on the Petkus, Bretagne, and Börris varieties. The aecidial stage of black rust of wheat (*Puccinia graminis*) was found on barberry bushes in several localities, including Møen's Klint [an island off the south-west coast of Zealand] where the cultivation of the shrub is permitted. It is regarded as urgently necessary to extend the barberry eradication regulations to this island. Foot rot of wheat and barley (*Fusarium*, *Leptosphaeria*, and *Ophiobolus* spp.) was specially severe in fields previously under barley or beets and mildest on ground which had lain fallow for some time.

LEGUMINOSAE. *Ascochyta pisi* completely destroyed the pea crops in a number of gardens, and *Sclerotinia sclerotiorum* also occurred with great severity during the damp late summer.

ROOT CROPS. Mosaic and downy mildew (*Peronospora schachtii*) resulted in severe damage to the beet crops; it is believed that insects and implements may be concerned in the transmission of the former disease. *Phoma betae* and *Pythium de Baryanum* were frequently found in non-calcareous or very compact soils. A severe wilt disease occurring in conjunction with deep sowing was reported from the north of Denmark. The Elvetham and Eckendorfer beet varieties were severely infected by *Hypochnus* [*Corticium*] *solani*.

CRUCIFERAE. Club-root (*Plasmodiophora brassicae*) occurred extensively on numerous varieties of cabbage, turnips, and mustard. The disease was frequently associated with non-calcareous or cold soils, and there were fresh instances of the transmission of infection through refuse. Dry rot (*Phoma napobrassicae*), which had been in abeyance since 1914, occurred on well-limed clay soil.

POTATOES. Mosaic and leaf roll occurred with unprecedented

severity in the hot, dry summer of 1921, and in 1922 the proportion of healthy fields was alarmingly low. The Magnum Bonum, Up-to-date, and Juli varieties were most susceptible. The absence of any organized scheme for the investigation of these diseases in Denmark is very regrettable. Blackleg (*Erwinia* [the new name given to various species of the genus *Bacillus* at the suggestion of the Society of American Bacteriologists] *phytophthora*) [*Bacillus atrosepticus*] was prevalent and severe in many parts of Jutland. Various other diseases of minor importance were recorded.

FODDER CROPS. The usual diseases were reported without any particulars of special interest.

FRUIT. On the whole, the damage caused by fungous diseases to apples and pears was not extensive. Raspberries were badly attacked by *Didymella applanata* on excessively nitrogenous soils in Fünen. Tomatoes were attacked by *Ascochyta lycopersici* [*Didymella lycopersici*], which also appears to prefer nitrogenous soils. *Cladosporium fulvum* attacked the Fillbasket, Denmark, Comet, Kondine Red, Tuckswood, and Queen Mary varieties.

CUCURBITACEAE. *Cercospora melonis* attacked the Tottenham variety of cucumber very early and severely. *Cladosporium cucumerinum* and *Macrosporium melophthorum* [mentioned as distinct fungi] were also prevalent.

ONIONS AND LEEKS. *Peronospora schleideni* caused severe damage to leeks and shallots.

VEGETABLES. Mildew of spinach (*Peronospora effusa*) was very severe on spring-sown plants and was observed as early as March on the Victoria variety under glass. *Bremia lactucae* was prevalent on outdoor salads at Lyngby in August. *Glomerella lindemuthianum* occurred with great severity on wax and French beans in August and September.

TREES, SHRUBS, AND ORNAMENTAL PLANTS. Among the diseases recorded were *Macrosporium caudatum* on zinnias [*Zinnia* sp.]. *Graphiola phoenicis* and *Exosporium preisii* on imported Phoenix palms [*Phoenix* sp.]. *Pestalozzia guepini* on camellias [*Camellia* sp.]. and *Bacterium tumefaciens* on marguerites.

In the section of the report devoted to diseases presumably of physiological origin, mention is made of the leaf edge disease of red Dutch and red Spanish currants, yellow apricots, and Cox's Orange apples. The disease was aggravated by the application of saltpetre. Bright speck disease [see this *Review*, i, p. 421, and ii, p. 403] was recorded on oats, barley, rye, Panser wheat (in conjunction with frost injury), beets, potatoes, and carrots. Indoor tomatoes were affected by a similar disease, presumably in consequence of plentiful applications of lime, bonemeal, and organic manure.

A brief account is given of the results of experiments in the control of plant diseases carried out during the year. Apples and climbing roses were injured by the application of 2 per cent. Burgundy mixture with the addition of 0·5 gm. Schweinfurt green per litre. The sale of this mixture is illegal on account of the free arsenious acid formed in it. Moltke pears suffered from scalding after spraying with 0·5 per cent. formalin. At the Lyngby Experiment Station 2 per cent. Bordeaux mixture injured Bismarck apples and several pear varieties, whereas lime-sulphur 1 in 35

produced no ill effects. In North Jutland the application of a tobacco extract, containing only a small proportion of nicotine, resulted in complete defoliation [crop not specified] owing to the presence of free ammonia in the compound.

[Bewley (W. F.)]. **Mycological Report.**—*Eighth Ann. Rept. Cheshunt Exper. and Res. Stat. Hertfordshire, 1922*, pp. 34–45, 1923.

Among the diseases not hitherto reported but observed during the year were the following: bronzing of roses, due to an unknown cause, dropsy or oedema of tomatoes and ivyleaved geraniums (of physiological origin), bulb rot of narcissus (due to *Botrytis* sp.), and mosaic diseases of ash, black nightshade (*Solanum nigrum*), *Petunia*, potato, tobacco, and passion flower [*Passiflora*].

The main object of research during the period under review was mosaic disease of the tomato and cucumber, but the new tomato root rot reported last year [see this *Review*, i, p. 372] and stem rot were also investigated.

The new tomato root disease was first observed in 1919, and in 1921 it was frequently found on roots of wilted plants. The results of local observations indicate that the disease is more serious than was at first assumed, most soils on which tomatoes have been grown for any length of time being infected.

The normal development of affected plants is checked, the lowest leaves turn yellow and die prematurely, and any new growth which may be formed is weak and pale in colour. In advanced stages the stem becomes hollow and yellow, a dark brown discoloration, usually about a quarter of an inch wide, sometimes appearing at one side of the base of the stem. 'Hollow stem' disease is often associated with this disease at the roots. In the final stages all the leaves wither and the plant dies. The distinctive feature of the disease is the presence of innumerable minute, globular, black sclerotia, both within the larger wood vessels in the pith cavity and on the outside of the wood. Those within the tissues are irregular in shape and rarely develop setae. Though generally confined to the roots, the sclerotia may also, in severe cases, be found on the base of the stem and the lower portion of the aerial parts. The infected wood is usually of a darker shade of brown than that attacked by *Verticillium albo-atrum* or *Fusarium lycopersici*.

The causal organism, *Sclerotium setosum* Bewley & Shearn, was readily isolated. The fungal filaments produced comparatively few conidia on short branches, and numerous black sclerotia approximately 1/200th of an inch in diameter and covered with black setae.

The fungus enters the plant through the roots and spreads rapidly upwards, sometimes reaching 32 inches above the ground level. Healthy plants grown in sterilized soil, copiously inoculated with sclerotia from a pure culture showed signs of root rot within six weeks and in three months the typical symptoms developed, the controls remaining healthy in each case. The fungus was readily re-isolated from the decayed roots. The results of inoculations above ground were negative, but both green and red tomato fruits were rapidly rotted by the fungus. The above results

indicate that the disease is contracted in the soil and that infection of the aerial portion rarely, if ever, occurs.

The investigation of control measures is still in progress. Available data point to the probable introduction of the disease in straw manure. An examination of tomato roots at the Experiment Station has shown that where no stable manure has been applied for five years the plants are healthy, while those which receive annual dressings of stable manure are badly diseased.

Stem rot of tomatoes, caused by a species of *Botrytis*, may be recognized by the grey or greyish-brown, slightly depressed, smooth patches extending up the stem and girdling it near the leaf or truss bases. In moist atmospheres the diseased portion becomes covered with a luxuriant grey mould composed of the spore-bearing filaments of the fungus. Infection takes place through jagged, badly pruned, half-dead leaf bases or leaves, and broken tissues, and the fungus attacks the cortex, vascular tissues, and pith, producing a brown discoloration. Spreading rapidly through the stem, the fungus causes the death of all parts above the lesion. Spore production takes place abundantly on leaves and fruits, which thus become a source of infection to the stems.

Preventive control measures should be based on a careful regulation of the ventilation, circulation, and humidity of the air, and on correct methods of pruning and defoliation. Severely infected plants can only be saved by the excision of the diseased portion of the stem and the sterilization of the wound with a strong solution of liver of sulphur or copper sulphate. In some cases the application of a paste of liver of sulphur to the outside of the lesion may suffice. Spraying with a 2 per cent. solution of calcium bisulphite is recommended for the destruction of the spores.

Mosaic disease of the tomato, the symptoms of which are described in some detail, is rapidly assuming considerable economic importance. Five main types of symptoms are distinguished, the first consisting of a simple mottling of the foliage without any distortion; the second type resembles the first, but the spots are indistinct in outline and deep yellow in colour (probably similar to the Aucuba mosaic of potatoes); the third type is characterized by a distortion of leaf margins with no mottling; in the fourth type the leaf surface is blistered and the margins distorted; and in the fifth type the lamina is severely reduced, resulting in the formation of tendril-like leaves. The evidence available at present goes to show that all these types are different manifestations of the same disease. Besides the mottling or blistering of the leaves, cohesion and twisting of the various parts of the flowers and sterility of the anthers are common symptoms of mosaic disease, but mottling of the fruits is uncommon in Great Britain. A mottling of tomato leaves also occurs as the result of unsuitable soil conditions, but this form of chlorosis differs materially from mosaic in the degree of infectiousness of the plant juices.

The results of inoculation tests on young Kondine Red tomato plants (*a*) with raw unfiltered juice and (*b*) with filtered juice showed that in the latter case infectivity, though present, is considerably reduced by filtration. The plants inoculated with unfiltered juice all became infected in a fortnight. Of the ten

varieties tested Fillbasket was the most susceptible. In another experiment three out of forty Ailsa Craig plants inoculated with infected juice showed no signs of disease after two months. The juice of these three plants was then inoculated into ten healthy plants with positive results in every case, thus indicating that a tomato plant may occasionally be infected without showing any external symptoms of disease. Such a plant is termed a 'carrier'.

Further tests indicated that the disease is readily transmissible by means of infected juice carried on the fingers and by the pruning knife. Aphids and white flies were transferred to healthy plants after feeding on diseased ones and transmitted the infection in every case. It was observed that low temperatures, by retarding the rate of growth, prevented the development of the typical symptoms found in rapidly growing plants at high temperatures. In the early part of the year there was a tendency towards blistering and distortion without mottling of the leaves, while the latter symptom was common at the higher midsummer temperatures.

The results of a large number of pot experiments showed that, with the exception of rather heavy feeding with a well-balanced fertilizer, none of the manurial treatments tested had any effect on the progress of the disease. This line of investigation is being continued.

It has been shown by cross-inoculation experiments that mosaic disease of tomato is readily transmissible to Petunia, tobacco, bittersweet (*Solanum dulcamara*), and black nightshade, and with difficulty to the potato, while it is also possible to cross-inoculate any of these from the other. Mosaic disease of cucumber has not been transmitted experimentally to any of the above plants.

Two types of cucumber mosaic have been observed in Great Britain, one resembling the Aucuba type, characterized by localized yellow patches, and the other marked by mottling and blistering of the leaves and stunting of the plants. Little damage is caused by the former type, but the latter frequently results in a considerable reduction of the crop. The observations on the effect of environmental conditions given above under tomato are applicable also to the cucumber. Butcher's Disease Resister is a very resistant variety.

No alternative hosts for cucumber mosaic have been discovered in Great Britain, and it must therefore be assumed that infection is transmitted by the seed. Control measures consist chiefly in the elimination of possible centres of infection on the lines suggested by the experimental work on tomato mosaic.

Annual Report of the Director, Wisconsin Agricultural Experiment Station 1921–1922, 121 pp., 53 figs., 1923.

Among the items of phytopathological interest not already separately noticed in this *Review*, the following may be mentioned. The prevalence of stripe disease (*Helminthosporium gramineum*) in the Wisconsin barley fields necessitated experiments carried out by Johnson and Holden to discover appropriate measures of control. In 1921 the seed of several plots was treated with formalin,

and then by roguing out any infected plants before any discharging lesions occurred, apparently disease-free seed was obtained. The latter was sown in 1922 and yielded a healthy crop with no trace of disease. The entire removal of infection was also accomplished by seed treatment with formalin, combined with planting at a period unfavourable to the development of the disease.

The season was favourable for the development of apple scab [*Venturia inaequalis*], experiments in the control of which were conducted by Keitt and Jones at Madison and Sturgeon Bay. The most satisfactory spray schedule consisted of lime-sulphur 1 in 40 (with powdered arsenate of lead, 1 lb. per 50 galls.) applied on the following dates: (1) 12th–13th May (pre-pink); (2) 18th–20th May (pink); (3) 29th May–1st June (calyx); (4) 8th–14th July; and (5) 5th–11th August. In most of the tests, the results from dry lime-sulphur 4 in 50 were similar to those obtained with liquid lime-sulphur 1 in 40. Bordeaux mixture 4-4-50 gave adequate control but seriously russeted the fruit. The addition of glue and gelatine as adhesives to lime-sulphur somewhat lessened the efficacy of the latter, whilst calcium caseinate added to lime-sulphur and Bordeaux mixture respectively, improved slightly the effect of these sprays. Trials to substitute dusting for certain liquid applications gave conflicting results, the success of the treatment apparently depending on the relation between the time of application and meteorological conditions. On the whole, three liquid lime-sulphur sprays followed by two sulphur dustings gave as good control as the five-spray lime-sulphur schedule.

The same workers carried out a series of experiments in the control of cherry leaf spot [*Coccomyces hiemalis*]. As in former years, excellent results were obtained by three applications of Bordeaux mixture 3–3–50, (1) just after the fall of the petals, (2) a fortnight later, and (3) just after harvest. Similar schedules of Bordeaux mixture 2–2–50, lime-sulphur 1 in 40, and dry lime-sulphur 4–50 failed to control the disease adequately. The addition of gelatine, glue, or calcium caseinate to Bordeaux mixture and lime-sulphur did not materially increase the adhesiveness of these sprays.

The investigations of the possible relation between the pigment, volatile oils, or associated substances in the onion and resistance to smudge (*Colletotrichum circinans*) were continued. From the chemical analysis the onion pigments appear to contain (1) a yellow non-glucoside, (2) one or more yellow glucosides, (3) a red non-glucoside, and (4) one or more red glucosides. A yellow glucoside or a mixture of glucosides has been crystallized from both the red and yellow onions, but so far has not been entirely purified. In the case of the yellow onions this mixture was found to be toxic to the fungus. These results open up an interesting field in the problem of the immunity of yellow onions and the susceptibility of white onions respectively to the disease.

Crown gall (*Bacterium tumefaciens*) of raspberries has for some years past been responsible for very heavy losses to Wisconsin growers, and experiments have therefore been carried out by A. J. Riker to ascertain the exact relation between the organism and its hosts. Inoculation experiments on the tomato showed that

wounds are necessary for infection. When needle punctures were made for inoculations the release of liquid caused the formation of water-soaked areas round the wounds. As the galls developed they were found to coincide closely in outline with the water-soaked regions. Expressed tomato sap was found to exert a positive attraction on the bacteria: the latter are thought to migrate through the water-soaked tissue and produce galls at points removed from the site of inoculation.

The results of further tests by Jones in the control of anthracnose [*Gloeosporium venetum*] of black raspberries showed that two applications of lime-sulphur alone controlled the disease sufficiently for commercial purposes, but that better results were obtained if glue, gelatine, casein, lime, or saponin were added to the spray as an adhesive. In general, Bordeaux mixture, either alone or with an adhesive, was slightly less satisfactory than lime-sulphur. A third application of Bordeaux or lime-sulphur about a week after blossoming reduced the amount of disease but caused severe foliage injury.

ARNAUD (G.). **Biologie des 'tumeurs marbrées' de la Luzerne.** [The biology of 'marbled galls' of Lucerne.]—*Comptes rendus Acad. d'Agric. de France*, ix, 18, pp. 494–497, 1923.

Since 1916, when the 'marbled gall' [*Urophlyctis alfalfae*] disease of lucerne was first recorded in France, the writer has continued his observations on the development of the galls and the immunity of other plants from the disease.

Various plants were sown in August 1916, the seed being mixed with fragments of lucerne galls. Lucerne was the only plant infected, and the disease has persisted in the plots since that date. The dissemination of the disease appears to be slow, since it has not yet spread to a plot of lucerne situated only about ten yards from the experimental plot.

As a rule the galls appear on the surface of the soil in the spring, persist throughout the year and die in the following spring. In the dry season of 1921 the disease did not appear at all, but was observed anew in 1922. Drought, therefore, appears to arrest the progress of the disease. The development of the galls of plants pulled up for examination and replanted was definitely checked and the hosts recovered their original vigour. On one occasion an attempt was made to control the disease by covering the soil with a layer of earth 5 cm. in depth. The following year, however, the galls reappeared at the original level. They were lighter in colour and had formed small roots on the surface.

So far the damage caused to the French lucerne crops by the marbled gall disease has been inconsiderable.

LEVIN (I.) & LEVINE (M.). **The action of buried tubes of radium emanation on neoplasias in plants.**—*Journ. Cancer Res.*, vii, pp. 163–170, 1 pl., 1922 [1923].

The clinical results of the insertion of buried capillary glass tubes containing radium emanation into animal tumours appeared to be of such importance that it was imperative to investigate biologically the mechanism of the action of this method of radium therapy

upon tumours in plants. The writers have previously shown (*Proc. Soc. Exper. Biol. & Med.*, xv, p. 24, 1917) that the main immediate action of X-rays on crown gall [*Bacterium tumefaciens*] in plants consists, not in a direct destruction of the cells, but in the arrest of their proliferating power. The death of the cells follows as a result of the ageing of the individual tumour cell.

In the present investigations capillary tubes 3 mm. long and 0·25 mm. in diameter containing radium emanation were introduced into artificially induced club-roots [*Plasmodiophora brassicae*] on cabbage and kohlrabi, and crown galls on the geranium, and left buried in the tissues from one to fifteen days. Empty tubes were similarly inserted in controls. The irradiated and non-irradiated tissues were then fixed and sectioned. These experiments showed that in normal adult tissue the only perceptible consequence of the insertion of a radium emanation tube is the complete destruction of tissue in the immediate vicinity. The insertion of radium emanation tubes into the crown gall tissue, however, is followed by an inhibition of the proliferation of the tumour, evidenced by its reduced size as compared with controls. The soft beta rays affect mainly the tissues in the immediate vicinity of the tubes, and in this region the cells collapse radially, forming a cushion of cellulose round each tube. The hard gamma rays penetrate beyond the cushion region, the cells becoming devoid of both nucleus and cytoplasm, and although no apparent morphological changes in the tumour cells may take place, the proliferating power is inhibited and the increase in size stopped. The rôle of the cellulose cushion in plants, in walling off the necrotic area around the radium emanation tubes and filtering off the soft beta rays, appears to correspond with that played by the connective tissue stroma in animal tumours. In club-root tissue the degenerated cells immediately adjoining the so-called cellulose cushion do not seem to contain *Plasmodiophora brassicae*, which, however, is present in the cells at a distance farther from the capillary tube.

LEVIN (I.) & LEVINE (M.). **The rôle of neoplasia in parasitic diseases of plants.**—*Journ. Cancer Res.*, vii, pp. 171–178, 1 pl., 1922. [1923].

In a previous investigation (*Journ. Cancer Res.*, v, p. 243, 1920) on the malignancy of the crown gall (*Bacterium tumefaciens*) and its analogy to animal cancer, the writers have demonstrated that the gall does not develop through the specific neoplastic 'gall producing' properties of the bacterium. The present paper reports further studies on the cause and mechanism of the formation of neoplasia in plants after their invasion by parasites.

After discussing the mechanism of gall formation in leafy crown gall [see this *Review*, ii, p. 396] and on *Ficus elastica* [see this *Review*, i, p. 54] the writers describe their studies on the club-root of cabbage (*Plasmodiophora brassicae*) and on potato wart (*Synchytrium* [*endobioticum*]).

Inoculations of young cabbage plants with an infusion of old club-roots in water were successful in producing infections, and suitable portions of the resulting hypertrophies or hyperplasias

were fixed and sectioned. Club-root is a plant tumour similar to crown gall in its derivation, mechanism of formation, and effect on the host plant. The most striking phenomenon observed in a study of club-root is the fact that the large groups of cells containing the parasite are always surrounded by layers of small young cells which do not contain the parasite. Kunkel (*Journ. Agr. Res.* xiv, p. 543, 1918) thinks that this is due to the growth stimulus travelling in advance of infection or that the uninfected cells are immune to the parasite. The author is of the opinion that these young undifferentiated cells are not only immune to the parasite but present a reactive protective barrier against further inroads of the latter (although this does not exclude the possibility of the parasites ultimately breaking through the barrier).

Examination of prepared slides of potatoes affected by wart disease showed substantially the same relationship between the parasite, the normal adult tissue of the host plant, and the reactive neoplastic tissue, as in crown gall and club-root.

In discussing these results, the authors state that neoplasia in parasitic diseases of plants, unlike the neoplasia in animal cancer, always represents a protective action of the plant organism against invasion of the parasite. It has a period of progressive proliferation of undifferentiated cells, which are frequently transformed into adult differentiated tissue, regression and death occurring before the destruction of the host, the gall thus behaving more like reactive neoplasia in an animal than animal cancer. Neoplasia in plants never represents a malignant tumour in the true meaning of the term in animal pathology. The points under consideration in these investigations make it evident that the study of neoplasia in plants should become an integral part of all phases of cancer research, etiological or therapeutical.

TABOR (R. J.) & BUNTING (R. H.). **On a disease of Cocoa and Coffee fruits caused by a fungus hitherto undescribed.**—*Ann. of Bot.*, xxxvii, 145, pp. 153–157, 3 figs., 1923.

Liberian coffee cultivated in the Gold Coast Colony is attacked by a fungus which produces a dark purplish-brown discoloration, especially of young berries, which eventually shrivel and harden. The discoloured area later becomes covered with a white or pinkish-brown mealy incrustation formed by the conidia of the fungus. In wet seasons the whole crop may be endangered by the attacks of the fungus, which is also responsible for a disease of cacao fruits. Cross inoculations from coffee to cacao and vice versa gave typical symptoms of the disease, the fungus being re-isolated in both cases.

In natural infections of cacao the symptoms of the disease—locally known as mealy pod [see this *Review*, ii, p. 203]—resemble those caused by *Phytophthora faberi*. The discoloured area at the point of infection rapidly extends until, under suitable conditions of humidity, the whole pod is involved, the white, later pinkish-brown, mealy conidia form dense encrusted masses, and the pericarp of the fruit becomes decomposed.

The results of inoculation experiments, while not conclusively proving the parasitic character of the fungus, indicate that the

latter develops more readily on wounded or moribund fruits than on healthy ones. It has never been found on the vegetative parts of its hosts. The effects of the disease are particularly serious on young pods in which the protective sclerotic tissues have not yet been formed, as the fungus is able to penetrate to the seeds.

The fungus produces in the host tissues a non-septate mycelium of rather coarse hyphae, which spreads rapidly through the intercellular spaces. Narrower branches arise from the intercellular hyphae and penetrate the walls of the cells, which are destroyed and their contents discoloured. The conidiophores are very variable in form, some consisting merely of upright hyphae terminating in a single conidium, while the more complex types bear terminal vesicles to which one or more whorls of pedicellate conidia or lateral fertile branches are attached. The conidia are spherical and markedly echinulate with an average diameter of 35 μ, borne on pedicels up to 30 μ in length. On cacao the conidia occur on the inner surface of the ovary wall, the mucilage sacs, and even in the wider intercellular spaces, as well as on the outer surface of the fruit. The conidia found in the internal cavities of the fruit (probably chlamydospores) are often larger than the normal type and always have thicker walls. Their germination has not been observed.

The normal conidia germinate readily in water and nutrient media, each producing a germ-tube which gives rise to a mycelium and subsequently to conidia as described above.

Sexual organs of the Peronosporaceous type are found, singly or in groups, in the host cells and occasionally in the mucilage cavities of the pericarp. They arise from the intracellular mycelial branches and may be accompanied by groups of rounded vesicles. The oogonia average 40 by 24 μ and are rather thick-walled with irregular sac-like excrescences. The antheridia are amphigynous, surrounding the stalk of the oogonium in the manner previously described for species of *Phytophthora* by Pethybridge (*Sci. Proc. Roy. Dublin Soc.*, xiii, 35, p. 529, 1913) [and this *Review*, ii, p. 181] and Dastur (*Mem. Dept. Agric. India*, v, 4, p. 177, 1913). The general relation between the sexual organs is also similar to that described by these authors. In ripe oogonia from desiccated pods the antheridia are readily detachable, the walls being intact and a distinct antheridial membrane surrounding that covering the stalk of the oogonium.

Preliminary cytological investigations indicate that the young oogonium is multinucleate, that little or no periplasm remains after the delimitation of the oosphere, and that the oosphere and the ripe oospore are uninucleate. The oospore has a fairly thin wall and practically no epispore. All attempts to induce the germination of the oospores gave negative results. The constant association of both sexual and asexual fruit bodies suggested a definite relation between them, and this was finally proved by tracing in artificial cultures the continuity of hyphae bearing conidia with those bearing oogonia. Up to the present no sexual organs have been found either in the tissues of the coffee pericarp or in artificial media prepared from coffee fruits.

Though certain morphological characters indicate a close relation-

ship to the genus *Phytophthora* and others point to an affinity with *Muratella*, the authors consider that the fungus in question differs sufficiently from both to justify the creation of a new genus, of the Peronosporaceae and it has accordingly been named *Trachysphaera fructigena*, a Latin diagnosis of both genus and species being given.

BUNTING (R. H.). **Mealy pod disease—a new foe to Cocoa.**—*Journ. Gold Coast Agric. & Comm. Soc.*, ii, 2, pp. 92–94, 1 pl., 1923.

The mealy pod disease of cacao, a scientific description of which is published elsewhere [see preceding abstract], has so far been recorded only from the Gold Coast. The causal fungus (*Trachysphaera fructigena*) penetrates the most minute wounds on young pods and destroys the beans, while it can also attack quite healthy, intact pods which have become detached from the tree.

The fungus flourishes as a mealy, white to pinkish mass of spores on the heaps of cacao husks from which the beans have recently been extracted. The spores [conidia] on the outside of the pod, transmitted by wind, rain, insects, &c., serve for the rapid propagation of the disease, while other spores [oospores] which are borne later, serve to tide the fungus over periods of drought.

For the control of the disease it is absolutely essential to remove and bury all diseased pods from cacao trees, and to bury all husks as soon as the beans have been extracted, thereby serving the double purpose of controlling the disease and providing food for the trees, which should be kept in a good state of cultivation to enable them the better to ward off the disease.

ROSEN (H. R.). **Septoria glume blotch of Wheat.**—*Arkansas Agric. Exper. Stat. Tech. Bull.* 175, 16 pp., 4 figs., 1921. [Received 1923.]

A marked spotting of the glumes and rachis of a large number of wheat varieties has been observed in Arkansas for several seasons. The most conspicuous symptoms appear on the outer glumes, the affected parts of which are covered with brownish or purplish-brown spots or blotches, with a hoary, brownish or greyish-white centre. On the rachis the discoloured areas are found at or near the joints, occasionally extending over the entire internode. The attacked parts are not sharply delineated, and there is no tendency to form streaks. The disease is not confined to glumes and rachis, but has also been noted on the leaves, leaf sheaths, and blades.

An examination of the diseased Arkansas material showed the causal fungus to be identical with *Septoria nodorum* [see this *Review*, ii, p. 211], which is synonymous with *Phoma hennebergii* Kuehn and *S. glumarum* Pass. There is little doubt that the Arkansas fungus differs from *S. graminеum* and *S. tritici*. In some respects it resembles *Ascochyta graminicola*, but a comparison of the spores revealed considerable differences. The following is a provisional technical description of the fungus: spots indefinite, often elliptical, varying in colour from greyish-brown to dark or purple-brown, often appearing light grey on a purple background;

occasionally a yellow, indefinite halo appears round the brownish discoloration. Pycnidia gregarious on spots of glumes, stems, and leaves, inconspicuous, subepidermal, opening by a small oval or roundish pore, golden-brown at first, finally blackish, globoid, 60 to 100 μ in diameter. Spores cylindrical, curved or straight, hyaline, often adhering to and issuing from the pycnidia in the form of serpentine threads, one to three septate, 18 to 25 by 2·8 to 3 μ, rounded above and truncate below, with or without guttulae.

Inoculations of wheat plants, under bell jars, resulted in various leaf and glume infections with the production of pycnidia on the spots. The spores from the pycnidia agreed in every respect with those observed in natural infections. Spores from the glumes infected leaves and vice versa.

The damage caused by the disease has not yet been fully investigated, but is known to be very serious. Standard winter wheat varieties, especially Red May and Kanred, are particularly liable to attack. Further investigations are in progress, and in the meantime the use of clean seed is strongly recommended.

WENIGER (WANDA). **Diseases of grain and forage crops in North Dakota.**—*North Dakota Agric. Exper. Stat. Bull.* 166, 92 pp., 32 figs., 1923.

In this bulletin the author describes the principal diseases of cereals (including also flax, proso or broom corn millet, buckwheat, and sorghum) and of forage crops (alfalfa, clovers, brome grass, millet, timothy, Sudan grass, wild grasses, and sunflower) as they occur in North Dakota, and then gives an account of the measures of control to be applied against them.

The work is prefaced by a table giving the losses caused by cereal diseases in North Dakota in the years 1919 to 1921, during which period the average loss of wheat was 26 per cent., the corresponding figures for oats, barley, rye, and maize being 7, 6, 2·3, and 1·8 per cent. respectively. The text is fully illustrated and many references to original papers are given. A feature of the report is the section dealing with the diseases of wild grasses, which constitute an important hay crop in North Dakota, covering over two million acres of land.

In the section on disease control, the author states that in North Dakota the formalin method of seed disinfection has proved extremely effective against all cereal diseases which are carried on the outside of the grain, such as barley stripe (*Helminthosporium gramineum*), wheat blights, anthracnose (*Colletotrichum cereale*), and bacterial diseases, and that such enormous injuries to germination as reported in the Western States have not been encountered. The dust treatment is not advocated at present. Very good results have also been obtained in the control of ergot of rye (*Claviceps purpurea*) by the immersion of seed in a 20 per cent. solution of common salt (40 lb. in 25 galls. of water) when the ergot bodies float to the surface and can be skimmed off. The grain should then be washed at least once with water to remove the salt, and it is recommended that the treatment should then be followed by the regular formalin disinfection.

STAKMAN (E. C.). **Barberry eradication prevents black rust in Western Europe.**—*U. S. Dept. Agric. Circ.* 269, 14 pp., 3 figs., 1923.

The present paper, written mainly for propaganda purposes, is the outcome of the author's visit to Western Europe during the spring and summer of 1922 to study the results of the eradication of barberry bushes in the control of black stem rust [*Puccinia graminis*] of cereals. In England and Scotland, where the farmers have eradicated the barberry, even without the aid of a law, black rust is very scarce, and in every case the few unimportant outbreaks still occurring could be traced to the immediate proximity of a forgotten barberry bush. In Wales, on the other hand, where the barberry has not yet been destroyed, the disease occurs frequently and causes appreciable losses. The most striking results were obtained in Denmark, which solved its black rust problem by a law passed in 1903 for the eradication of the barberry: since 1904 there has not been a single general epidemic of the disease in that country; the rust is seldom found, and when it does occur a guilty barberry is also found. In some districts of Sweden there are still large numbers of barberries, and in those regions the attacks of black rust are very heavy. Between Stockholm and Upsala, in the summer of 1922, fields of oats were black with rust, which could be traced directly to the barberry bushes, such a condition occurring year after year. In Holland, France, Germany, Czecho-Slovakia, and Hungary the correlation between the occurrence of the disease and the existence or absence of the barberry was also found. Even in the most southern European countries, Spain, southern Italy, and southern Greece, where the climate is sufficiently warm during the winter that the summer stage of the rust is sometimes not killed, the rust is evidently most destructive near barberry bushes.

LUDWIGS (K.). **Beobachtungen über die Bodensäurekrankheit an Getreide.** [Observations on soil acidity disease of cereals.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iii, 6, pp. 41–42, 1923.

During the spring of 1923 a disease of cereals (especially rye), which began to attract attention in 1920 and is believed to be due to excessive acidity of the soil, caused very severe damage in various parts of the province of Brandenburg.

The symptoms of the disease include arrested development of the entire plant, yellowing of the leaves, a dark discoloration of the markedly elongated roots, and a great reduction in the number of root hairs. During periods of protracted drought the young plants collapse entirely. In many cases the leaves become covered with irregular, dun-coloured spots surrounded by a dark edge, such as are associated with bright speck disease of oats [see this *Review*, i, p. 421, and ii, p. 403]. Oats are usually less severely attacked, recovery after sufficient rain being frequent, and wheat is only slightly affected in the districts west of the Oder. The loss of this year's oat crop in Westhavelland is, however, estimated at 50 to 80 per cent.

There seems to be little doubt that the local practice of applying

large quantities of acid fertilizers (potassium, superphosphate, and sulphate of ammonia) to the soil is largely responsible for the occurrence of the disease. The deficiency of lime, from which, according to Gisevius and other authorities, more than half the soils of North Germany and Bavaria are suffering, has led of late years to an increasing reduction in the German harvests. The liberal application of lime is the only means of remedying this serious defect and cannot be recommended too strongly.

LIPSCOMB (G. F.) & CORLEY (G. L.). **A new treatment of Cotton-seed to destroy anthracnose.**—*Amer. Fertilizer*, lviii, 6, pp. 32–34, 1 fig., 1923.

Repeated attempts have proved the impossibility of adequately controlling anthracnose of cotton (*Colletotrichum gossypii*) by means of fungicides, as the disinfectants are incapable of penetrating the seed coat and reaching the fungus. The selection of uninfected seed for planting, by the inspection of the bolls, has proved quite impracticable, whilst the selection of resistant varieties does not appear promising. The hot-water treatment of the seed was also abandoned, the thermal death-point of the fungus being too near that of the seed. The claim that the use of three-year-old cotton seed eliminated anthracnose is not supported by the results of recent germination tests, which have shown that infection may even occur in five-year-old seed.

The authors' investigations indicate that one of the most important factors governing the vitality of cotton seed in high temperatures is the presence or absence of oxygen. By thoroughly drying and heating the cotton seed in a vacuum or any inert atmosphere, such as nitrogen, to prevent oxidation of the fats and proteins in the seed, they will endure 100° C. for hours without any diminution of vitality, and even 110° to 120° C. for several hours without destroying life. The heating for 26 hours at 100° C. of Weber 49 seed not only stimulated germination to a remarkable extent, but also controlled anthracnose. In all the tests highly infected Weber 49 seed was used; further experiments with other varieties are now in progress.

The apparatus used in the drying and heating of cotton seed is constructed as follows: A glass tube about 12 in. in length and 0·8 in. in diameter is drawn out at the top and a small tube sealed on, to which a rubber tubing can be fastened. The cotton seeds are placed in the bottom of the glass tube and, in order to hold them in position and prevent the calcium chloride from mixing with them, a thin layer of glass wool is placed over the seeds, and above the glass wool calcium chloride is placed to a length of 4 to 5 inches. A thermometer is inserted in the tube, the bulb extending to about the middle of the cotton seeds, and the oxygen is removed by means of a mercury or oil vacuum pump. When the manometer connected in the circuit registers one mm. or less, the small glass tube is sealed. After the cotton seeds have been dried in this way for several days the tube is placed in boiling water to such a depth that the water stands just above the seeds.

When nitrogen was substituted for air, the cotton seeds were thoroughly dried and placed in the tube with calcium chloride

as described above. The air in the tube containing the seeds was displaced by nitrogen being passed in (through a tube which led to the bottom of the seed container), until all the oxygen was expelled, a small side tube forming an outlet for the air. Both tubes were then sealed. After the cotton seeds had remained in the tube for several days at the ordinary room temperature or heated several hours in water at 50° to 60° C. they were then heated for 26 hours in boiling water. The seeds germinated, with the result that no anthracnose appeared and the percentage of germination was higher than in the control.

Other samples of cotton seeds were treated in the same way except that the seed was heated to the boiling-point of toluene, 109° C., and also to that of glacial acetic acid, 119° C., for several hours. After heating for 10 hours at 110° C. the percentage of germination was somewhat lower than the control and some of the seedlings were less vigorous.

KING (C. J.). **Cotton rootrot in Arizona.**—*Journ. Agric. Res.*, xxiii, 7, pp. 525–527, 1923.

The Texas root rot of cotton has been generally regarded as being caused by *Ozonium omnivorum*, although definite proof of this has been lacking. During the seasons of 1921 and 1922 the fungus was abundant at Sacaton, Arizona, especially the conidial form *Phymatotrichum omnivorum* previously described by Duggar (*Missouri Bot. Gard. Bull.* v, 3, p. 11, 1916) and a study of the disease (which also attacks alfalfa) was therefore undertaken.

The behaviour of the fungus as shown by the spread of the disease in alfalfa fields was very suggestive of fairy rings. The outer ring of the circle consisted of recently dead plants, an inner ring or 'bare zone' was occupied only by the stubble of dead plants, and a patch in the centre contained re-established plants arising from the fragments of partially destroyed crowns or roots. It is evident, therefore, that the disease spreads from a centre in ever widening circles, leaving the spots over which it has passed free from the disease until re-infected. In badly infected fields the crossing and re-crossing of the widening circles may entirely obscure the fairy ring effect.

Under Arizona conditions abundant crops of fruiting bodies, which enhance the resemblance to fairy rings, appear on the periphery of the circles, shortly after the occurrence of rainy weather. The newly formed fruiting bodies appear as felt-like mats on the surface of the ground, or in cracks or depressions, seldom being found more than six or eight inches from the outer circle of recently wilted plants. They have been known to cover more than 300 sq. ft. of soil surface in a 22-acre alfalfa field where three or four acres of the plants had died.

In alfalfa fields it was found possible to prevent the further spread of the disease in small, circular areas by thoroughly saturating the soil to a depth of 4 ft. with a solution of 40 per cent. formalin 1 in 100. The mycelium evidently extends a foot or more in advance of the last affected plant, since it was found necessary to include the soil 18 inches outside the apparent periphery in alfalfa fields. With cotton plants the mycelium appears to extend

for at least 2½ ft. in advance of the recently wilted ring. In no case, however, has the disease reappeared where the treated area extended as far as 3 ft. outside the wilted ring. The best method of applying the treatment is to throw up a small dyke round the affected area and pour in the solution gradually. None of the areas in alfalfa fields treated as described above in July and August 1922 showed further disease activity after two months. In the control areas, where the dykes were thrown up but no fungicide applied, the infection progressed from 4 to 4½ ft. during that time. In the treated areas of cotton fields there was no reappearance of the disease at the end of seven weeks, whereas in the control areas the disease advanced from 6 to 8 ft. during the period.

Artificial inoculation experiments were undertaken in August 1922, normal cotton plants in healthy soil being exposed at the roots and one-inch sections of cotton roots infected by root rot placed in direct contact with them. After three weeks following a rainy period one of the plants treated in this way wilted suddenly, and on being pulled up was found to be covered with the characteristic mycelium of the root rot fungus. Within five days four other inoculated plants died in the same way, but owing to the depletion of the moisture on the sides of the trench the disease could make no further progress.

Pure cultures were prepared from the mycelium isolated from the first wilted plant, and were used for further inoculations. Two rows of cotton plants were separated by a trench, and on one side ten plants were inoculated with the pure culture and four left as controls, and on the other, the fourteen were treated with diseased roots as described above. By 20th September the disease had appeared in all but a few plants on both sides of the trench, including the four controls, which were attacked by the mycelium spreading through the soil from the inoculated plants. By 1st October the mycelium had spread from the pure culture row to plants growing 3½ ft. away. None of the plants of a corresponding series, the roots of which were inoculated with spores of the fungus, showed any sign of infection after seven weeks.

Spores collected from fresh fruiting roots were induced to germinate in distilled water and artificial media after several days, but the resulting growth was extremely slow. This is not surprising, since, if the conditions necessary for the development of the spores were not very exacting, the enormous quantities in which the latter are produced would long ago have ensured the universal distribution of the disease.

It is of great importance to ascertain whether the promising results of the control experiments are applicable in other regions.

NAKATA (K.) & TAKIMOTO (S.). **Studies on Ginseng diseases in Korea.**—*Bull. Agric. Exper. Stat., Chosen*, v, pp. 1–18, 6 pl., 1922. [Abs. in *Japanese Journ. of Botany*, i, 3, pp. 43–44, 1923.]

The most important fungous diseases of ginseng [*Panax quinquefolium*], which is very extensively cultivated in Korea, are red rot (*Bacterium araliavorus* Uyeda), leaf blight (*Colletotrichum panicicola* n. sp.), and amber-coloured rot (*Bact. panaxi* n. sp.). The first-

named disease has already been described by Uyeda (*Bull. Centr. Agric. Exper. Stat., Tokyo*, xxxv, 1909).

Leaf blight attacks leaves, stems, and seedlings, causing a reduction of 50 per cent. in the yield. The affected parts have a felt-like appearance, in which they differ from the leaf spot caused by *Alternaria panax* Whetzel. The disease is promoted by the filtering of sunlight through the chinks of the sun-screen and by humidity. Spraying with Bordeaux mixture is an effective control measure.

Amber-coloured rot causes the decay of roots and stems, to which a water-soaked appearance is imparted. In advanced stages of the disease only the vascular fibres remain. Infection occurs in the winter and is therefore frequently overlooked. No effectual remedy has been found.

Other diseases of minor importance are: sclerotial disease, caused by a species of *Sclerotinia* which differs morphologically from *S. libertiana* and in growth temperature from *S. panax*; black dry rot (*Phoma panacicola* n. sp.), stem-rot (*Phoma panacis* n. sp.), snake-eye disease (*Phyllosticta panax* n. sp.); damping-off (*Corticium vagum* [*solani*]), bending-off (*Phytophthora cactorum*), dry rot (*Cladosporium* sp.), soft rot (*Mucor* sp.), and white spot similar to papery leaf).

Hiltner (L.) & Lang (F.). **Ueber den Einfluss der Düngung, insbesondere mit Kalkstickstoff, auf die Stärke des Brandbefalls des Getreides.** [The influence of fertilization, especially with calcium cyanamide, on the intensity of smut attacks on cereals.]—*Mitt. deutsch. landw. Gesellsch.*, xxxvii, 16, pp. 253–257, 1922.

In the autumn of 1919 a series of experiments on the effect of the fertilization of winter wheat (Ackermann's Dickkopf) on the incidence of bunt [*Tilletia tritici* and *T. levis*] was carried out at two separate branches of the Bavarian Plant Breeding and Plant Protection Institute, near Munich, the soil in one locality being stony with an admixture of humus, and in the other consisting of heavy loam. Calcium cyanamide (30, 90, and 120 kg. per hect.), Rhenania phosphate (45, 135, and 180 kg. per hect.), and potassium chloride (60, 138, and 240 kg. per hect.), were applied to the soil the day previous to sowing with wheat, which was infected with the spores of bunt.

On both soils the application of potassium chloride resulted in an increase in the incidence of attack. Rhenania phosphate (180 kg. per hect.), however, considerably reduced the percentage of infection, whilst the effect of the calcium cyanamide applications was much more marked. Even at the rate of 30 kg. per hect. it reduced the amount of infection on the stony soil from 22·6 to 4·36 per cent. and on the loam from 13 to 10·7 per cent., while at 120 kg. per hect. infection in both places was reduced to a trace (0·84 and 0·57 per cent.). Even more favourable were the results of fertilizing with all three substances (calcium cyanamide 120 kg. per hect., Rhenania phosphate 180 kg. per hect., and potassium chloride 240 kg. per hect.), which reduced the infection to a minimum in both localities (0·52 per cent.). Hitherto such results have only been obtained by the use of first-class seed disinfectants.

Similar results were obtained in 1921 in experiments with smutted millet, the application of 200 kg. of calcium cyanamide per hect. reducing infection from 37·5 to 5·7 per cent. Calcium cyanamide also controlled smut of oats [*Ustilago avenae*] and bunt of summer wheat, while ammonium sulphate saltpetre gave negative results. Applied to wheat infected with loose smut [*U. tritici*], however, calcium cyanamide failed to reduce the percentage of disease. In a further test the incidence of loose smut of barley [*U. nuda*] was found to be greatly increased by fertilizing with sulphate of ammonia (30, 90, and 120 kg. per hect.), with or without the addition of basic slag and potassium chloride. The results of a preliminary test of the effect of sulphate of ammonia on bunted wheat were favourable.

It is suggested that calcium cyanamide should be applied to the soil by means of a drill, or else that the seed should be encrusted with the substance.

RITZEMA BOS (J.). **Over den invloed der bemesting met kalkstikstof op de intensiteit van de aantasting van het graan door brand.** [The influence of fertilization with calcium cyanamide on the intensity of smut attacks on cereals.]—*Tijdschr. over Plantenziekten*, xxix, 5, pp. 93–94, 1923.

Referring to the experiments of Hiltner and Lang [see preceding abstract] on the effect of fertilizing with calcium cyanamide on the incidence and severity of smut diseases of cereals, the author questions the utility of the method as a general substitute for seed disinfection with copper sulphate, which combines excellent fungicidal properties with great facility of application.

On the other hand, there is some prospect that calcium cyanamide might be used with advantage in the control of loose smut of oats [*Ustilago avenae*], as in this case treatment with copper sulphate or hot water is injurious to the seed and formalin only gives moderately satisfactory results.

CURTIS (K. M.). **Two fungal diseases of the blue Lupin.**—*New Zealand Journ. of Agric.*, xxvi, 4, pp. 240–246, 9 figs., 1923.

The blue lupin (*Lupinus angustifolius*), which is cultivated for cover-cropping in the Nelson District of New Zealand, has recently been attacked by two fungous wilts caused by *Botrytis cinerea* and *Ascochyta pisi* respectively. The diseases usually occur together under conditions of excessive atmospheric and soil humidity, *Botrytis* wilt tending to predominate. This disease is also the more economically important of the two, since it attacks particularly the cultivated lupin. In severe cases of stem infection the upper portion of the plant gradually wilts, the leaves turning yellow and eventually falling. The stem lesions, which vary in length from one half to nine inches, occur principally at soil level, but may also be found on any part to a height of two feet upwards. The affected epidermal cells turn brown and the diseased area assumes a transparent appearance, the edge of the infected area sometimes showing an abrupt rise in level as it merges into the healthy region. As a rule the stem is completely girdled by the fungus, and the outer tissues of the plant become permeated with mycelium. The

development of the conidia and sclerotia is described and figured. The latter remain on the ground near the dead plants during the winter, giving rise to a fresh crop of conidia in the following spring. Thus the persistence of the fungus into a second year is secured.

The wilt caused by *Ascochyta pisi* is more prevalent on self-sown than on cultivated lupins. The general symptoms are similar to those described above, but as the plants are generally weakly from the outset they succumb more readily than the vigorous cultivated lupins attacked by *B. cinerea*. The large lesions vary from six to eighteen inches in length and completely encircle the stem, the numerous smaller lesions accompanying them being only about one quarter of an inch in diameter and circular in outline. The dark brown colour of the diseased region merges gradually into the normal tone of the stem, and there is no abrupt change of level between infected and healthy tissue as with *B. cinerea*.

The life-history of the fungus is described and figured. The spores emerge from the pycnidia in long, thread-like masses on to the surface of the plant, where they are freely distributed by the agency of water. The similarity of *Ascochyta* on lupin to that which occurs on pea, bean, and vetch, viz. *A. pisi* Lib. (*Mycosphaerella pinodes* [B. and Blox.] Niessl.), strongly suggests that the two species are identical, especially in view of the fact that lupins growing near peas attacked by *A. pisi* were similarly affected.

Lupins should not be planted in damp soil and great care must be taken to avoid overcrowding. Seed for planting should only be taken from healthy fields and rotation of crops should be practised wherever the disease has become established.

Selby (A. D.) **Fungus diseases of the Apple.**—*Amer. Fruit Grower*, xliii, 2, pp. 9 & 14, 1 fig., 1923.

The major bacterial and fungous diseases of the apple in Ohio are black rot [*Physalospora cydoniae*], scab [*Venturia inaequalis*], fireblight [*Bacillus amylovorus*], blotch [*Phyllosticta solitaria*], bitter rot [*Glomerella cingulata*], sooty blotch and fly speck [*Leptothyrium pomi*], and the new *Phoma* fruit spot. The adoption of a regular spraying programme for apples has already given good results in Ohio and the following schedule is recommended [see also this *Review*, ii, p. 442]: (1 a) Delayed dormant for control of San José scale. (1 b) Pre-pink application of Bordeaux mixture 4–6–50 for control of scab and black rot. (2) Same materials as (1 b). This is the most important spray of the season and should be applied when the buds show pink before the opening of the blossoms. (3) Calyx spray, to be given just after petals fall. (4) Bordeaux mixture and arsenate of lead, applied two weeks after the foregoing. This is a critical time in the control of midsummer diseases (blotch, scab, black rot, and the new *Phoma* fruit spot). (5) Special blotch spray, applied 2½ weeks later than (4). This may be omitted in the absence of severe infection. (6) Second brood codling moth spray, Bordeaux mixture 2–4–50 and arsenate of lead, should be applied 9 to 10 weeks after (3). This is important in the control of blotch, bitter rot, scab, sooty blotch, codling moth, and *Phoma* fruit spot. (7) In cases of severe late season infection an additional application

of the same material as (6) should be given during the second half of July in southern Ohio, and late July or early August in the north of the State.

FARLEY (A. J.) **Dry-mix sulphur lime. A substitute for self-boiled lime-sulphur and summer strength concentrated lime-sulphur.**—*New Jersey Agric. Exper. Stat. Bull.* 379, 16 pp., 2 figs., 1923.

The difficulties involved in connexion with the preparation and handling of the various sulphur fungicides for fruit trees have been largely overcome in New Jersey by the adoption of the following formula known as the 'dry-mix sulphur lime': sulphur 8 lb., hydrated lime 4 lb., calcium caseinate 8 oz. (for 50 gallons of spray mixture). The results of a series of experiments in the control of peach scab [*Cladosporium carpophilum*] and brown rot [*Sclerotinia cinerea*] showed that spraying with dry-mix sulphur lime gave almost complete control, being superior to self-boiled lime-sulphur, atomic sulphur, and a New Jersey dry-mix sulphur lime containing only 2 lb. of sulphur. Good control was also obtained with New Jersey sulphur glue mixture (sulphur 8 lb., hydrated lime 4 lb., and ground glue 8 oz.). Atomic sulphur and sulphur dusts caused serious defoliation.

Dry-mix sulphur lime was also found to cause much less russeting and defoliation of apple trees than the ordinary lime-sulphur compounds.

MASSEY (L. M.) & FITCH (M. W.). **Some results of dusting experiments for Apple scab and for Peach leaf curl in 1921-1922.**—*Proc. New York State Hort. Soc. 1922*, pp. 42-60, 1923.

Excellent results in the control of apple scab [*Venturia inaequalis*] and codling moth were obtained in 1921 on the Greening, Fall Pippin, Baldwin, Ben Davis, and Northern Spy varieties at Ravena, Albany County, by the application of 15 lb. dry lime-sulphur, 10 lb. arsenate of lead, and 75 lb. finely ground sulphur. Very satisfactory control was also given by a sulphur-lead arsenate dust (90:10), and by liquid lime-sulphur (1 in 15 at the delayed dormant application and 1 in 40 at subsequent treatments) plus lead arsenate ($2\frac{1}{2}$ lb. per 100 galls. of spray). Black leaf 40 was also added at the delayed dormant and calyx sprays at the rates of $\frac{3}{4}$ and 1 pint per 100 galls. respectively. The seven applications of both dusts and sprays were given on the following dates: 13th April, 25th April, 12th May, 28th May, 27th June, 23rd July, and 19th August.

In 1922 similar experiments were carried out at Waterport and Medina, Orleans County, on the Greening, Baldwin, Dutchess, Wealthy, and Wolff River varieties. The best results were given by the application of liquid lime-sulphur 1 in 40, but various dusts also controlled the disease adequately.

The most satisfactory control of peach leaf curl [*Exoascus deformans*] was obtained by the application of liquid lime-sulphur (1 in 40 and 1 in 20) and by Corona 'coppercarb' dust (60 per cent. soluble sulphur and 40 per cent. inert material, 7 lb. on nine trees).

BUTLER (O.). **Bordeaux mixture. II. Stimulatory action.**—*New Hampshire Agric. Exper. Stat. Tech. Bull.* 21, 49 pp., 24 tables, 1922. [Rec'd. 1923.]

After a somewhat detailed review of the work of previous investigators on the stimulatory effect of Bordeaux mixture, the author gives an account of his studies on the nature of the response in sprayed plants.

Dealing first with the effect of the composition of Bordeaux mixture on the dry matter formed and on the transpiration per gram of dry matter, the author describes experiments in which tomatoes, beans, and radishes were sprayed weekly with 1 per cent. Bordeaux mixture in which the ratio of copper sulphate to quicklime used was 1 to 1, 1 per cent. Bordeaux mixture in which the ratio of copper sulphate to lime was 1 to alkalinity, and milk of lime containing 1·32 per cent. calcium hydroxide. The plants were grown in glazed pots filled with soil containing water to 70 per cent. of saturation. As regards the elaboration of dry matter, in six-sevenths of the experiments the application of 1 per cent. Bordeaux mixture 1 to 1 and milk of lime was accompanied by loss of weight, whilst the plants sprayed with 1 per cent. Bordeaux mixture 1 to alkalinity behaved approximately like the controls.

Spraying with 1 per cent. Bordeaux mixture 1 to 1 always increased transpiration per gram of dry weight, an effect which was also produced in five-sevenths of the tests with milk of lime. Taking the experiments as a whole there was only a negligible difference in the rate of transpiration per gram of dry matter between the plants sprayed with Bordeaux mixture 1 to alkalinity and the controls.

The data obtained from the above experiments show that the physiological effect produced by Bordeaux mixture is due to the ratio of copper sulphate to quicklime, and not to the amount of copper present. The ratio of copper sulphate to lime does not, within the limits used, affect the composition of the copper precipitate, and it therefore follows that a Bordeaux mixture made with an excess of lime should produce a response of the same order that the calcium hydroxide present would. This is actually the case, since 1 per cent. Bordeaux mixture 1 to 1 has the same physiological effect as 1·32 per cent. calcium hydroxide.

The author next describes his experiments on the effect of the percentage of water in the soil on the response of plants sprayed with Bordeaux mixture 1 to 1. Tomato, bean, and radish, were again used. The degree of saturation in the different series of pots ranged from 50 to 90 per cent. and the plants were sprayed at weekly intervals. In general the application of the mixture was detrimental to the formation of dry matter in the plants investigated, especially the tomato. In the case of the latter and of the bean the percentage of water in the soil in no way influenced the result. With radishes, however, 11·2 per cent. of those grown at 70 and 80 per cent. saturation, 25 per cent. of those at 90 per cent. saturation, and 66 per cent. of those at 50 per cent. saturation showed an increase in dry weight as a result of spraying. The percentage of water in the soil, however, has a modifying influence, sprayed plants growing in too dry a soil being less deleteriously

affected by spraying than plants growing under more favourable conditions as regards soil moisture.

The effect of spraying on the transpiration of plants growing in soils of varying degrees of saturation (50 to 90 per cent.) was investigated and it was found that transpiration per gram of dry matter produced was increased in 94·5 per cent. of the cases when tomatoes were used, and in 68·9 and 64·3 per cent. when radishes and beans respectively were employed. When this criterion is considered the plants fall into the same relative position as when dry weight is taken as a criterion. Both in the case of dry weight and transpiration per gram of dry matter the degree of illumination was without perceptible effect.

The effect of the Bordeaux mixture on the dry weights of the plants (also grown in soils of varying degrees of saturation) was not materially modified by the addition of nutritive elements to the sand in which they were grown. The transpiration of both sprayed and non-sprayed plants, however, was less when grown in fertile than in poor sand. Comparative observations on the coloration of the foliage of sprayed and unsprayed plants indicate that the action of Bordeaux mixture, whatever its nature, is indirect.

In a further series of experiments on potato, tomato, Russian sunflower, *Coleus* Golden Bedder, and *C. verschaffiei*, it was shown that spraying has no effect on the rate of transpiration (irrespective of the relation to dry weight) when the data are calculated for the entire 24-hour period or for the day alone, while during the night there may or may not be an increase in the rate of transpiration of the sprayed plants. In the case of tomato and *C. verschaffiei* increased transpiration at night was recorded in all the tests; in *Coleus* Golden Bedder it occurred in 50 per cent. of the experiments, in the sunflower in five out of seven instances, and in the potato once only. Plants sprayed with Bordeaux mixture 1 to 0·2 behaved similarly to those sprayed with 1 to 1 under the same environmental conditions, though the increased transpiration obtained was less. Milk of lime also produced comparable results except in the case of two experiments on the sunflower. The available data indicate that spraying the under surface of the leaves affects the rate of transpiration in the same way as when the mixture is applied to the upper surface.

It was further ascertained by experiments, the technique of which is described in detail, that Bordeaux mixture 1 to 0·2 transmits 1·62 times more light than Bordeaux mixture 1 to alkalinity; the 1 to alkalinity wash 1·53 times more than milk of lime; and milk of lime 2·2 times more than Bordeaux mixture 1 to 1. Considering the spectrum as a whole, Bordeaux mixture 1 to 1 and milk of lime are about equally transparent and much more opaque than Bordeaux mixture 1 to alkalinity, and there is an agreement between the physical properties of the solutions and the response of the plants sprayed with them. Bordeaux mixture 1 to 1 casts an obvious shadow, and plants sprayed with it remain longer green than the unsprayed controls, thus behaving in all respects like shaded plants. The quality of the light received by the leaf was found to play no part in the effect produced. An investigation of the transmission of radiation by the solutions in question showed

that all were relatively opaque to the infra-red, Bordeaux mixture 1 to alkalinity and 1 to 1 especially showing a high degree of athermancy.

The action of Bordeaux mixtures on plants is seen from the above experiments to be one of shade, using the term in the sense of opacity to the spectrum as a whole. The magnitude of the physiological response produced in plants by the application of Bordeaux mixture depends, broadly speaking, on the intensity of the shadow cast. A Bordeaux mixture transparent to the spectrum permits a plant to grow in all respects like unsprayed plants, whereas milk of lime and opaque mixtures cause a decrease in dry matter and an increase of transpiration. As Bordeaux mixtures and milk of lime are opaque to radiation of long wave length, sprayed plants, under conditions favourable for radiation, cool less rapidly than unsprayed ones and thus transpire more freely.

The practical conclusions to be drawn from the above facts are as follows. When shading is injurious to the plants to be sprayed, only a small amount of lime should be used, the composition of the mixture being 1 to 0·5. When shading is desirable a 1 to 1 Bordeaux mixture should be used for the control of parasitic organisms, and milk of lime employed when fungicidal properties are a secondary consideration.

STUTZER (A.). **Die Steigerung der Ernteerträge durch Beizung des Saatgutes.** [The increase of crop yields through seed disinfection.]—*Deutsche landw. Presse*, l, 5, p. 42, 1 fig., 1923.

Some years ago the writer ascertained that lead salts (lead nitrate) were extremely effectual as a seed disinfectant. Not only were the various parasitic organisms adhering to the seed destroyed, but a portion of the lead remained in the epidermis and adjoining layers of the seed, where it exerted a remarkable influence on the development of the root system and eventually resulted in a higher yield than that obtained from untreated seed. There was no reduction of germination such as so frequently accompanies the use of copper sulphate.

Similar results have more recently been secured by the use of uspulun. Reports have been received from a Mexican cotton farm to the effect that seed treated with uspulun in 1921 and 1922 yielded a cotton the fibre of which was longer and finer and fetched a considerably higher price than that from the untreated plants.

APPEL (O.). **Die Steigerung der Ernteerträge durch Beizen des Saatgutes.** [The increase of crop yields through seed disinfection.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxviii, 8, pp. 37–39, 1923.

After describing the various types of seed disinfection apparatus, the author selects a few instances in which such treatment is of special use. Smut diseases of cereals, stripe disease of barley [*Helminthosporium gramineum*], and *Fusarium* disease of rye, are now very generally controlled by immersion of the seed in disinfectants. The farmers of Bavaria, where conditions predispose to *Fusarium* disease, set the example in this direction. It is now

customary also to control root rot (*Phoma* sp.) of beet by steeping the seed for 20 to 24 hours in 5 per cent. carbolic water or 2 per cent. Bordeaux mixture. The immersion of various vegetable and flower seeds in mercury preparations, especially with a view to stimulating germination, is rapidly gaining ground.

In 1922 experiments in the immersion of seed potatoes in uspulun gave excellent results both as regards speedy germination and general vigour, although it is not possible to say if this result is due to control of *Rhizoctonia* or to stimulation of the potato. Further experiments with seed potatoes are planned which it is hoped will give data as to the value of the process.

GEHRING (A. A.) & POMMER (E.). **Ueber die Wirkung verschiedener Beizmittel auf Rüben.** [On the effect of various disinfectants on Beets.]—*Deutsche landw. Presse*, l, 16, p. 147, 1923.

During 1922 a series of field tests was carried out at the Brunswick Agricultural Experiment Station in continuation of the laboratory experiments already reported [see this *Review*, ii, p. 224]. Owing to the absence of root rot [*Pythium de Baryanum* and *Phoma betae*] the efficacy of the fungicides in this respect could not be put to the test, but various other points of interest were noted.

The 'seed clusters' were immersed, after one hour's preliminary soaking, in germisan 0·25 per cent., uspulun 0·25 per cent., segetan 10 cc. in 1 l., or carbolic acid 1 per cent., for one hour, and subsequently planted out, on 5th May, on heavy clay soil. On 19th July it was observed that the treated plants had developed much more regularly and vigorously than the controls. On 20th October the plants were harvested, the highest yield being obtained from those treated with segetan and the lowest (except the controls) from the plot treated with carbolic acid. The highest sugar-content was found in the beets treated with uspulun, but the other fungicides also gave an increase over the controls.

In a second test carried out on good soil in the Weser valley, the 'seed clusters' were immersed for one hour in 0·1, 0·25 or 0·50 per cent. germisan. There was no increase in yield, but the sugar-content was augmented in this case also.

REMY (T.) & VASTERS (J.). **Untersuchungen über die Wirkung von Chlorphenol-Quecksilber, Sublimat und einigen andern Pflanzenschutz- und Desinfektionsmitteln.** [Investigations of the action of mercury chlorophenolate, sublimate, and some other means of plant protection and disinfection.]—*Landw. Jahrb.*, lviii, 3, pp. 379–480, 5 figs., 1923.

The opening section of this very comprehensive survey of the composition, application, and effects of certain well-known fungicides deals with the work of previous investigators from 1913 to 1920, with numerous bibliographical references. The second part of the paper is devoted to the authors' original research work at Bonn Agricultural College, extending over the period 1915 to 1920.

The authors present their results under two headings: (*a*) the effect on germination and yield; (*b*) the disinfection efficiency.

The results of the germination tests, which were carried out with formaldehyde, copper sulphate, mercury chlorophenolate, and sublimate on selected seed of wheat, rye, barley, and oats, showed that much greater injury was caused by excessive concentrations of the fungicide than by protracted immersion in a solution of normal strength. Unfortunately, prolonged immersion does not increase the protective action of the substances, or only slightly. A series of experiments was also carried out on wheat in which the period of steeping lasted one hour but in which the concentrations of the fungicides varied so as to determine the safety limits for their use. Formaldehyde, 2 in 1,000, greatly reduced germination and at 4 in 1,000 completely inhibited it. The safety-limit for formaldehyde is between 1 and 2 in 1,000, probably nearer 1. Copper sulphate impaired germination only at the strongest concentration of 40 in 1,000, and the limit therefore lies between 20 and 40 in 1,000. Mercury chlorophenolate in no case reduced germination, which was, however, somewhat delayed at the highest concentration, 2 in 1,000. Sublimate adversely affected germination at 1 or 2 in 1,000, and slightly retarded it even at the lowest concentration of 0·5 in 1,000. The final results of the latter treatment, however, were satisfactory. In judging these results it must be remembered that the susceptibility of cereals to the action of the different fungicides varies considerably from one season to another and is also to some extent an individual peculiarity. The locality of origin and the variety of grain must also be taken into consideration.

Disinfection tests were carried out on wheat and other cereals inoculated with *Tilletia caries*, *Rhizopus nigricans*, *Aspergillus niger*, *Penicillium glaucum*, *Fusarium metachroum*, and *F. rubiginosum*. Mercury chlorophenolate was almost uniformly more effective than sublimate in the control of all the fungi tested.

Laboratory and field experiments were made on naturally infected seed of wheat, oats, barley, rye and beet to test the value of germisan, uspulun, and formaldehyde (separately and in combination), fusariol, and copper sulphate. No improvement in the germination of seed which had been damaged during harvesting or storage was ever obtained by any of the substances tested. In the case of rye infected with *Fusarium* [*nivale*], mercury chlorophenolate, sublimate, and formaldehyde, stimulated the germination. Good results in the control of the diseases were secured with formaldehyde (0·5 in 1,000). Mercury chlorophenolate and sublimate were equally effective in the control of *Fusarium* and stripe disease of barley [*Helminthosporium gramineum*]. Sublimate was slightly superior to mercury chlorophenolate in the control of bunt. Sprinkling the seed with sublimate, 0·787 in 1,000, and mercury chlorophenolate, 1 in 1,000, very considerably reduced the incidence of bunt, but even better results were obtained by immersion at much lower concentrations (mercury chlorophenolate 0·25 in 1,000, and sublimate 0·098 in 1,000).

In 1921–22 complete control of bunt was secured by germisan 25 in 1,000, formaldehyde 1 in 1,000 (or 2 in 1,000 with subsequent rinsing), and sublimate 1 in 1,000. Approximate freedom from

infection was obtained by immersion in uspulun 2·5 in 1,000, in a mixture of germisan 0·83 in 1,000 + uspulun 0·83 in 1,000 + formaldehyde 0·67 in 1,000, and in fusariol as directed. None of the preparations was completely effective in guarding against subsequent reinfection; the best results from this point of view were obtained by the use of copper sulphate. Solutions of uspulun, sublimate, germisan, and formaldehyde could safely be used three times in succession. In no case were uninjured spore balls completely destroyed, though in a recent experiment (1923) copper sulphate almost entirely inhibited their germination. Low concentrations of sublimate and uspulun even appeared to stimulate the germination of the balls. The removal of the spore balls before or during treatment is therefore an essential preliminary.

Cattle, pigs, and poultry can safely be fed on grain treated with uspulun, sublimate, formaldehyde, copper sulphate, or germisan.

Uspulun deserves special consideration at the present time on account of its relative cheapness [British price 13*s.* 0*d.* per lb.] It has the further advantage of causing comparatively little damage even at excessive concentrations. Germisan [7*s.* 10*d.* per 500 gm. or 1·1 lb.] has also given excellent results, which, however, require further confirmation before the preparation can be widely recommended.

DUFRÉNOY (J.). **La lutte contre les maladies des plantes par la sélection des races immunes.** [The campaign against diseases of plants by the selection of immune varieties.]—*Rev. Bot. appliquée*, iii, 20, pp. 241–246, 1923.

In a brief survey of the practical importance of the selection of immune or resistant varieties of plants in the fight against disease, the author gives a number of well known examples of the success of this method. Its value has been fully demonstrated in such cases as wart disease of potato (*Synchytrium endobioticum*), cereal rusts, sugar-cane diseases, chestnut diseases, and the like. In certain instances, however, such as *Sclerotinia trifoliorum*, little success has been met with, since all varieties of clover appear to be susceptible to this fungus, and the same is true of *Plasmodiophora brassicae* on cabbage.

DOOLITTLE (S. P.) & WALKER (M. N.). **Cross-inoculation studies with Cucurbit mosaic.**—*Science*, N.S., lvii, p. 477, 1923.

Cross-inoculation experiments with cucumber mosaic have been continued with the result that 8 genera, 23 species, 8 varieties, and 96 horticultural varieties from Europe, Asia, and Africa are now known to be susceptible to the disease. In the genus *Citrullus* infection was secured only in the case of the green-seeded citron. It was shown in an earlier paper [see this *Review*, i, p. 122] that cucumber mosaic was transmissible to *Martynia louisiana*, pepper (*Capsicum annuum*), and milkweed (*Asclepias syriaca*), and more recently pokeweed (*Phytolacca decandra*) was also found to be susceptible. Further studies have demonstrated that cucumber mosaic is readily transmissible to these hosts and back to the cucumber. The disease has also been transmitted from milkweed to both *Martynia* and pepper and back to milkweed. The most

uniformly successful method of inoculation was by means of aphids. Inoculation with the crushed tissue or expressed juice of mosaic plants gave satisfactory results.

The authors also found that cucumber mosaic was readily transmissible to tobacco through pepper and vice versa, the pepper apparently acting as an intermediate host. Their numerous direct inoculations from cucumber to tobacco have hitherto given negative results, though Elmer [see this *Review*, ii, p. 21] reports the successful inoculation of cucumbers with tobacco mosaic and vice versa.

A high percentage of infection was secured in several series of inoculations on the cucumber from potato plants previously inoculated with cucumber mosaic. Potato plants inoculated from the cucumber in 1921 yielded tubers which when planted in the greenhouse during the past winter produced plants showing symptoms of mosaic. The results of preliminary experiments indicate that potato mosaic may possibly be transmitted to the pokeweed. During the summer of 1922 it was discovered that cucumber mosaic was transmissible also to the pigweed (*Amaranthus retroflexus*) and a cultivated ground cherry (*Physalis* sp.).

KOTILA (J. E.) & COONS (G. H.). **Trypanosome-like bodies in Solanaceous plants.**—*Phytopath.*, xiii, 7, pp 324–325, 1923.

Nelson's paper relating to the occurrence of protozoa in plants affected with mosaic and related diseases [see this *Review*, ii, p. 227] stimulated the authors to investigate whether similar phenomena were to be met with in potato and other plants affected with other degenerational diseases.

Diseased material from plants showing severe symptoms of potato mosaic, streak, and leaf roll was killed and fixed with both chrom-acetic and Zenker's solutions. Longitudinal sections 7 μ thick were prepared and stained with Heidenhain's haematoxylin.

The phloem cells of the diseased potato plants were found to contain inclusions resembling the trypanosome-like bodies described by Nelson, and similar bodies were also found in the phloem cells of midribs and lateral veins of leaves of tobacco and petunia plants affected with mosaic.

As a control the same work was done on material from healthy potato and tomato plants. In order to ensure the supply of healthy potato material for these tests, the stock from which it was taken was indexed during the winter 1921–1922 (that is, an eye of a tuber was sprouted and grown in the greenhouse to about 10 inches in height and if any plants showed disease the parent tubers were rejected). The stock thus obtained was grown in an isolated plot in 1922 and found to be healthy. Some of the progeny of this stock was indexed again during the winter 1922–1923 in a greenhouse. No aphids were observed on the plants selected for study, nor were signs of mosaic or leaf roll detected by the time the plants had reached a height of 8 inches and the material was cut and fixed. The variety used, Bliss Triumph, allows of an easy and prompt recognition of either mosaic or leaf roll. Tomato material was obtained by planting disinfected seed on agar in Petri dishes and transferring the seedlings after germination to test tubes (plugged

with cotton) containing Shive's nutrient agar. Allard and others contend that tomato mosaic is not transmissible through the seed, so the precautions taken are believed to exclude the possibility of infection.

The phloem elements of healthy potato and tomato plants were found to contain inclusions similar in size and form to those found in severely diseased material and equally abundant. No degree of uniformity was possessed by these bodies in either diseased or healthy material. All attempts to show definite structure by using such protozoal stains as Wright's, Romanowski's, tetrachrome, &c., failed, the bodies staining a uniform blue, nor has it been possible to prove motility, in sections of fresh material or in extracted juice of diseased or healthy plants.

The conclusion is reached that the correlation of the trypanosome-like bodies described by Nelson with mosaic and leaf roll has not been proved.

DOOLITTLE (S. P.) & MCKINNEY (H. H.). **Intracellular bodies in the phloem tissue of certain plants and their bearing on the mosaic problem.**—*Phytopath.*, xiii, 7, pp. 326–329, 1 pl., 1923.

This paper records the results of the authors' study of phloem tissue of both mosaic and healthy plants. The material consisted of stem and petiole phloem of navy beans, tomatoes, cucumbers, and red clover, both healthy and mosaic-infected, and of healthy garden peas, sweet peas, and alfalfa. In most cases free-hand sections of fresh material were studied side by side with material fixed, embedded, sectioned, and stained by the usual methods.

The precautions taken in order to obtain mosaic-free plants are described. The mosaic-free bean and tomato plants used for the experiments were grown in an isolated greenhouse at the University of Wisconsin, in which no mosaic plants were found either before or after the material for study was removed, although light and temperature conditions were favourable to the development of the disease. As an additional safeguard, healthy tomato plants were inoculated with the juice from the healthy plants sectioned, but the former developed no mosaic, while similar healthy plants inoculated at the same time with material from the mosaic plants studied developed the disease. The other plants were selected with similar care.

Certain intracellular bodies very similar to those described by Nelson as protozoa in the phloem of certain mosaic plants, were found in the phloem of both mosaic-free and mosaic-infected plants [see also preceding abstract]. In beans, three to six weeks old, they were discovered in fresh and in microtomed material, the latter being stained either by Fleming's triple stain or by Heidenhain's iron-alum haematoxylin. The bodies were found singly in the sieve-tubes and adjoining cells, oriented longitudinally. In shape they varied from irregularly ovoid to narrowly ellipsoid and usually had one or more slender strands extending from each end, sometimes to the ends of the cells and sometimes shorter distances from the bodies. Though the stains employed should have brought out cytological details if these had been present, the characteristic nuclei, blepharoplasts and rhizoplasts of protozoa were not observed

by the authors, nor were they able to note in free-hand razor sections of fresh material an active motion of the bodies such as might suggest that of a protozoon. Similar bodies were observed in healthy and mosaic-infected red clover, as well as in healthy garden peas, sweet peas, and alfalfa, except that the terminal strands were only occasionally seen in clover and alfalfa and not at all in garden or sweet peas.

Strasburger (*Histologische Beiträge*, iii, pp. 193–194, Jena, 1891) reported finding in the sieve-tubes of *Robinia pseudacacia* certain slime-bodies which resemble in many respects those found by the writers in beans, clover, garden peas, and sweet peas. He described them in some detail and found them to colour a yellow-brown with iodine and to react intensively to Millon's reagent, the threads being only weakly stained. Strasburger's original figures are reproduced by the authors.

Haberlandt also states that these bodies occur generally in the Leguminosae, but not in the Cucurbitaceae, this statement agreeing with the findings of one of the authors, who was unable to detect them in the phloem tissues of stems and petioles of either mosaic-infected or mosaic-free cucurbits.

The intracellular bodies, which appear to be identical with those interpreted by Nelson as trypanosome-like protozoa, are not found as regularly in the tomato as in the bean, but they seem to be as abundant in the mosaic-free as in the mosaic-infected tissues, and the most careful investigation has failed to reveal structure typical of trypanosomes or other protozoa. Both healthy and diseased plants show the cytoplasm of the phloem cells frequently collected in lightly stained, long or short, irregular, spiral, wavy forms in all stages up to the deeply stained forms referred to, but an undulating membrane characterizing the trypanosomes has never been observed by the authors.

BAILEY (I. W.). **Slime bodies of Robinia pseudo-acacia L.**— *Phytopath.*, viii, 7, pp. 332–333, 1 pl., 1923.

Robinia pseudacacia is characterized by having curious 'slime-bodies' (Strasburger's Schleimklumpen) [see preceding abstract] in its sieve-tubes, which stain intensively in Millon's reagent and vary greatly in size and shape during different stages in the differentiation of the sieve-tubes. At first small, slender, spindle-shaped structures, they enlarge later, frequently tending to be bifurcated at the ends and are held in place by slender threads attached at the ends of the spindle. As the 'slime-bodies' enlarge laterally, these strands become thicker and more conspicuous. The author thinks that the structures described and figured by Nelson in the phloem of bean and clover affected with mosaic are identical with the slime-bodies occurring normally in the sieve-tubes of *Robinia* and other Leguminosae. All the forms described by Nelson are taken on by the slime-bodies of *R. pseudacacia* during various stages in the differentiation of the phloem, although in the case of these large trees they are somewhat larger in size.

The movements recorded by Nelson in fresh sections of living material mounted in boiled water must be considered normal, as the stresses and strains in the various tissues are changed in cutting

the sections, the osmotic and other equilibria being also disturbed by immersion in water. The liquid or semi-liquid contents of the cells must also contribute to this disturbing influence through their circulatory motion.

KOFOID (C. A.), SEVERIN (H. H. P.), & SWEZY (OLIVE). **Nelson's spiral bodies in Tomato mosaic not protozoa.**—*Phytopath.*, viii, 7, pp. 330–331, 1923.

The authors record their total disagreement with Nelson's interpretation of the bodies found in plant tissues affected with certain mosaic diseases [see also preceding abstracts]. In material from both healthy and mosaic-infected tomato plants, fixed in hot Schaudinn's fluid and stained in the usual way in iron haematoxylin, structures clearly similar to those described and figured by Nelson were found, but the absence (1) of the undulating membrane, (2) of the flagellum having a definite, clear-cut, marginal fibril arising from a centrosome, and (3) of the parabasal body near the end of the fibril and joined to the centrosome by the parabasal rhizoplast, exclude the possibility of their being trypanosomes, nor is their spiral form characteristic of either trypanosomes or of any known protozoa. Other characters generally associated with the latter bodies are also lacking. These spiral bodies of the tomato do not belong to the same category as the clearly established trypanosomes of the latex of Euphorbiaceous plants.

No evidence of motility was detected at any time by the authors in the spiral bodies, but it is stated that occasionally reagent bottles, particularly those containing physiological salt solution, in use in the laboratory, become contaminated with a species of *Bodo*, a small, rapidly-moving flagellate, and these might appear in preparations made up with such contaminated solutions, deceiving the observer as to their origin.

Similar spiral bodies have been found by the authors in mosaic-free seedling tomato plants and in the diseased phloem of older plants, with the difference that in the former they were smaller, but whether this has any connexion with the age or the disease of the plant the authors are unable to say; the peculiar relations of these spiral structures, in their elongated, trumpet-shaped phase, to the sieve-plates in some instances, their relative homogeneity, and their spiral structure, induce, however, the belief, that they are dexiotropic cell contents of an albuminoid nature.

DORAN (W. L.). **Effect of external and internal factors on the germination of fungous spores.**—*Bull. Torrey. Bot. Club*, xlix, 11, pp. 313–336, 2 diag., 1922.

In this work the effect of various factors on the germination of spores of the following fungi was studied: conidia of *Venturia inaequalis*, *Sclerotinia fructigena*, *Alternaria solani*, *Botrytis cinerea*, and *Rhizopus nigricans*, aecidiospores and uredospores of *Cronartium ribicola*, aecidiospores of *Gymnosporangium clavipes* and teleutospores of *Puccinia malvacearum*. In all cases except that of *A. solani* the spores were obtained fresh from the living host, being thus presumably possessed of their full natural vigour.

In the experiments (the technique of which is described) on the

relation of the viability of the spore to its age, it was found that mature spores (especially those which have just reached maturity) can germinate through a wider range of environmental conditions than either immature or old ones. As the spores advance in age viability decreases, sharply at first and then gradually. The longevity of spores is dependent on conditions of storage after detachment from the host, moisture being of more importance than temperature in this connexion.

Dealing with various external factors on germination the author first discusses that of temperature. A table is given of 33 records of the cardinal temperatures of various fungi. From this it is seen that the minimum temperatures for spore germination are 1° to 7·4° C., the optima 13° to 23·1° C., the maxima 22° to 39·6° C. The Phycomycetes can germinate at the lowest minimum temperatures, followed in order by the uredospores, aecidiospores, and teleutospores of the Uredinales. Aecidiospores have the lowest optimum temperatures for germination, followed in order by uredospores, conidia of Phycomycetes, teleutospores, and spores of Fungi Imperfecti. The writer determined the minimum temperature for the germination of conidia of *Venturia inaequalis* as 3°, the optimum 14°–15°, and the maximum 31° C., the decrease in germination being more rapid from the optimum to the minimum than from the optimum to the maximum. From a study of the published figures the length of time required for spore germination was found to be about 12 hours, the different groups varying from 4 to 21 hours, and the author adds his own figures for six other species which varied from 2 to 27 hours. The nearer all conditions approach to the optimum, the shorter is the time required for spore germination. With regard to oxygen relations, the literature is reviewed on this subject and the author points out that competition or crowding inhibits germination and this is attributed to a deficiency of oxygen. The spores of the fungi studied germinated indifferently in light or darkness. Precipitated moisture was found to be essential to the germination of the conidia of *S. fructigena* and *Peronospora pygmaea*, which was also studied in this connexion, but *G. clavipes* germinated equally well merely in water vapour. In the case of *A. solani* and *V. inaequalis*, both germinated very poorly in water vapour but very well in a drop of distilled water.

A bibliography of 59 titles is appended.

SPIECKERMANN (A.). **Wie kann die weitere Verbreitung des Kartoffelkrebses in Deutschland verhindert werden?** [How can the further spread of wart disease of Potatoes in Germany be checked?]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxviii, 13, pp. 175–178, 1923.

Wart disease of potatoes [*Synchytrium endobioticum*] first began to cause serious alarm in Germany in the summer of 1922, when it appeared on a large scale in the potato-growing districts east of the Elbe. The disease had occurred in a sporadic form in Germany since 1908, but until recently it was confined almost entirely to small holdings in the manufacturing districts, and therefore did not materially affect the agricultural population. Subsequent developments, however, have thrown an entirely new light on the situation

and demonstrated the need for the most stringent legislative measures to combat the further spread of the disease.

The symptoms of the disease and life-history of the causal organism are briefly described. It is pointed out that, besides the usual agents of dissemination (rain, labourers, and animals), particles of infected soil adhering to apparently healthy tubers are responsible for a certain amount of infection (10 per cent. in recent tests in Westphalia). The danger of infection by this means is particularly great from starch factories, where potatoes of widely varying origin are washed before use.

The amendment and extension of the legislative measures against wart disease which came into force in September 1922 [see this *Review*, ii, p. 335] will doubtless cause serious inconvenience to distillery owners and others, but from the standpoint of national welfare they are absolutely justified.

All attempts to control wart disease by seed tuber disinfection have hitherto given negative results, and although further experiments on these lines are in progress, the only reliable method of suppression at present is the cultivation of immune varieties. Among the latter, Paulsen's Juli and Goldperle combine early maturity with delicate flavour and yellow flesh. Modrow's Johannsen and Preussen are good medium-early varieties, though both are unfortunately apt to 'degenerate'. Immune early varieties with white flesh are Thiele's Früheste, Kuckuck, Magdeburg Blaue, and possibly also Bürkner's Früheste. There are as yet no immune medium-early, white-fleshed varieties, but a number of valuable medium-late ones, the best of which is Richter's Jubel, followed by Pepo, Arnica, Marshal Hindenburg, Helios, and Nepeta. Parnassia deserves special mention as being the only immune variety with a high starch content. This list will doubtless be amplified by investigations now in progress.

In 1922, 30 per cent. of the potatoes grown in Brandenburg were immune varieties, in Pomerania 31 per cent., and in Hanover and East Prussia 12 per cent. During the last three years the area occupied by immune varieties has increased considerably in all parts, especially in Silesia and Brandenburg.

The author regards the danger of the importation of wart disease with consignments of potatoes from abroad as comparatively slight. Of far greater importance than frontier inspection, essential though it be, is the reduction of the infected area at home. This object can be attained only if the legislative measures are reinforced by the willing co-operation of all classes concerned.

SCHRIBAUX. **Sur la dégénérescence de la pomme de terre et sur les moyens de la conjurer.** [The degeneration of the Potato and the means of preventing it.]—*Comptes rendus Acad. Agric. de France*, ix, 3, pp. 95–97, 1923.

Potato cultivation in France appears to be passing through a serious crisis as potato growers, in addition to mildew and filosity, now have to contend against various insidious and obscure diseases, such as verticilliose, rhizoctoniose, leaf roll, curl (frisolée), &c.

Experiments conducted at Grignon by Ducomet in 1921 and 1922 have shown that none of the 180 varieties tested was abso-

lutely immune from 'degeneration' diseases. In view of the hereditary character of these diseases, individual (not mass) selection of healthy tubers between the end of June and middle of September is absolutely essential. Of 440 'families' from 40 varieties cultivated by Ducomet, three-quarters had to be eliminated; in 11 varieties not a single 'family' was preserved. These figures show the necessity of rigorous and persistent individual selection.

BOTJES (J. O.). **Die Verwendung unreifer Kartoffeln als Saatgut.** [The use of unripe Potatoes for seed.]—*Deutsche landw. Presse*, l, 13, pp. 118–119, 1923.

The use of unripe potatoes for seed has given very conflicting results both in Germany and elsewhere. In a series of experiments carried out by Dr. Münter at Halle during the years 1918 to 1921 there was a marked improvement in the yield, especially of the Wohltmann variety, from unripe tubers on soil where potatoes are liable to 'degeneration' but in stocks free from such diseases no such improvement took place.

In the writer's opinion this increased yield is due to the fact that the unripe tuber is severed from the vegetative portion of the plant before the virus of mosaic and other similar diseases has time to pass from the former to the latter; such a tuber would in all probability produce sound offspring.

NEWTON (R. G.). **Experimental work with potatoes.** — *Agric. Journ. Brit. Columbia*, viii, 4, pp. 80–81 & 86, 1 fig., 1923.

For the last four years experimental work on virus diseases of potatoes has been in progress at the Invermere Experimental Station, which is situated at an altitude of 2,700 ft. in the Kootenay Valley. Varieties affected with mosaic to the extent of 100 per cent. have increased in yield during the period under review and shown no signs of degeneration. This is believed to be due much more to environmental and climatic conditions than to selection. Leaf roll, curly dwarf, and allied diseases can be virtually eliminated by roguing and rigid individual tuber selection at planting time.

In spite of the general adoption in British Columbia of seed disinfection with corrosive sublimate, *Rhizoctonia* causes a heavy reduction in the yield. Common scab [*Actinomyces scabies*] is also very severe, but may be controlled, at any rate on the resistant Cambridge Russet variety, by the application of 600 lb. of agricultural sulphur per acre.

MILLARD (W. A.). **Common scab of Potatoes II.**—*Ann. Appl. Biol.*, x, 1, pp. 70–88, 2 pl., 1923.

Following his previous work [see this *Review*, ii, p. 138] on common scab (*Actinomyces scabies*) the author in this paper deals first with green manuring treatment for the disease, secondly with the action of liming on the organism, and thirdly with theoretical considerations arising from the above.

The three manuring experiments recorded were carried out in

1920 when the amount of disease present was small, but they indicated that green manuring was very effective in reducing scab.

Further experiments in 1921 using seeds hay (2½ and 5 tons per acre) and spent hops as substitutes for green manure showed that the former was very little use, while in the latter case the heavier dressing gave very good results and further trials with this apparently worthless product are warranted.

The effect of lime dressings on scab varies with the reaction and type of soil to which they are applied. In the experiments described, two acid soils and two approximately neutral soils were limed. In the former case, scab followed, whilst in the latter case there was no effect, and there is little doubt that many of the conflicting statements regarding the results of liming might be reconciled if the initial soil reaction was known. The lime requirement serves as a useful guide in predicting the action of lime on scab.

Further experiments are described which show that the appearance of scab following liming may be counteracted by green manuring.

In examining the theories advanced to account for the occurrence of scab and its prevention by green manuring the author first discusses the soil reaction theory. He has not found the hydrogen-ion concentration of the soil to be a direct factor in controlling scab, a statement which is supported by the fact that (1) scab, although usually absent from acid soils, may occur in soils with as low a P_H value as 4·4; (2) in more nearly neutral soils the P_H value of the soil and the incidence of scab are not related, as is shown by the fact that one soil having a hydrogen-ion exponent of 7·0 may yield absolutely clean crops, whilst another with the same P_H value may bear very scabby crops, a distinction which cannot be explained by supposing the former soil to be virgin and uncontaminated with scab; (3) the application of green manure seems to decrease rather than increase the hydrogen-ion concentration of the soil.

The most plausible explanation of the established facts in connexion with the occurrence or absence of scab is thought by the author to lie in his preferential food theory. If the soil is well supplied with vegetable matter in a palatable state for the *Actinomyces*, the crops will be clean. The organisms remain saprophytic until their natural food supplies are exhausted, and only under the stress of hunger will their parasitic tendencies be developed. The freedom of peat soils from scab may be explained by the large natural reserve of organic matter present, and whilst the author agrees that high acidity depresses the *Actinomyces* flora, a peat soil which has a P_H value of 7·1 was found to contain 5,000,000 organisms per gram and yielded clean crops. Scab is most prevalent on light sandy and gravelly soils, where the well aerated conditions bring about the rapid disappearance of farmyard and vegetable manure. The fact that the incidence of scab sometimes resulting from liming may be counteracted by heavy dressings of green manure also supports the author's theory.

Dry seasons are more favourable to scab than wet, no doubt owing to the higher soil temperature in dry weather, but rainfall, which modifies the air content of the soil and thus regulates the

development of the strongly aerobic scab organisms, is the most important factor, as is seen in clay soils where the disease is almost entirely inhibited by a wet season.

Goss (R. W.). **Relation of environment and other factors to Potato wilt caused by Fusarium oxysporum.**—*Agric. Exper. Stat. Nebraska Res. Bull.* 23, 84 pp., 5 figs., 1923.

A critical review of the literature dealing with potato wilt caused by *Fusarium oxysporum* shows that the general opinion of the widespread activity and serious character of the disease is based upon insufficient data. Much of the experimental evidence is contradictory and there has been a general failure to reproduce the symptoms of the disease as it occurs in the field. On the whole, the available data do not justify the conclusion that *F. oxysporum* is an extremely virulent parasite, but rather suggest a lack of knowledge of the influence of various factors upon the occurrence of the disease. The object of the present work was to determine the effect of some of the complex of factors which influence the development of the disease.

There are three methods of infection of potato plants by *F. oxysporum*: (1) infection from the soil through the seed tuber; (2) from the soil through the roots and stem; and (3) infection from the seed tuber. The results of experiments showed that the second is the most prevalent method of infection in Michigan and Nebraska. The distribution of the disease is widespread, the organism being universally present even in virgin desert and forest soils. The accurate determination of the losses caused by this disease is almost impossible owing to the complexity of the factors governing its incidence and to the liability of confusion with other troubles. Of recent years the highest reported losses in the six leading potato-growing States are 6 and 5 per cent. in 1918 and 3 per cent. in 1919 and 1920.

As a preliminary to the study of the influence of temperature on the disease, the growth-temperature relations of the organism in pure culture were investigated. It was found that different strains of *F. oxysporum* vary by at least 5° C. in their optimum temperature for development, the differences being more marked in liquid than in Petri dish cultures. By the use of different liquid media it was possible to cause a reduction of 5° to 10° C. in the optimum temperature for growth. These data may account for the varying results reported by different investigators, and also show that the manifestation of the disease at certain temperatures may depend on the strain of organism studied.

Pathogenicity tests indicated that *F. oxysporum* is not a very virulent parasite and they also showed that potato plants are most susceptible to infection in the early stages of growth. Under conditions favourable to the plant infection may often occur without producing any external symptoms of the disease. On the other hand, a discoloration of the vascular system of both stem and tubers is often apparent under conditions of high temperature and low soil moisture, even in the absence of a specific causal organism. It is, therefore, not a reliable indication of infection by *F. oxysporum* unless associated with a wilting of the plant. Only a small

percentage of tubers with a vascular discoloration contain *F. oxysporum*, and such tubers do not usually reproduce the disease except under conditions very favourable for this type of infection. They should not, however, be used for seed, as they produce weak plants which are very susceptible to soil infection.

A large number of experiments are described showing the effect of soil temperature and moisture on the disease, but the amount of infection secured by artificial inoculations was so small that definite interpretations of the results were difficult to make. Temperatures of 18° C. and below, however, are very unfavourable for the development of the disease, the amount of infection increasing with a rise in the soil temperature up to 30° C. The disease develops most rapidly when the temperatures are too high for the vigorous growth of the host. Plants started at a temperature of 18° C. and later transferred to higher temperatures showed as much disease as those kept at a constant high temperature. Conversely, plants started at a high temperature and afterwards transferred to a low one showed practically no symptoms of disease although the organism was present to a slight extent in the finer rootlets. Constant low soil moisture is unfavourable for infection. After the plants have become infected, however, a reduction of the soil moisture accelerates the wilting of the plant. With increasing soil moistures the amount of rotting of the stems and roots of infected plants increases and the wilting symptoms are less marked. The results of experiments with seed inoculations under three different environmental conditions showed that the greatest amount of disease developed in the plot with low soil temperatures during the early period of growth, and with a decreasing soil moisture content and rising soil temperatures in the later stages. The application of two irrigations during the later period of growth rendered the plants more vigorous and reduced the amount of disease. Practically no disease developed in another plot with the same general type of temperature and moisture curve as in that showing the greatest amount of disease, but with much higher temperatures and soil moistures throughout the experiment.

Cook (F. C.). **The influence of copper sprays on the yield and composition of Irish Potato tubers.**—*U.S. Dept. of Agric. Bull.* 1146, 24 pp., 1923.

The results of experiments with (*a*) ordinary Bordeaux spray, prepared by mixing milk of lime and copper sulphate solutions; (*b*) Pickering spray, prepared by mixing a saturated solution of lime water with a dilute solution of copper sulphate; and (*c*) a barium water spray, prepared by mixing barium hydroxide with a dilute copper sulphate solution, showed that the tubers of sprayed potato plants were usually higher in solids, starch, and nitrogen than those from the untreated controls. The starch content of the sprayed plants increased approximately 50 per cent. as the tubers matured, while the dextrose disappeared and the sucrose was materially reduced. The early varieties of potatoes showed a decrease in their sugar content and a corresponding increase in their starch content in the copper-sprayed tubers during the early stages of development. In sprayed plants also the proportion of

insoluble ash decreased during the growth of the tubers, though the total ash content remained constant. The total nitrogen increased, and the figures for soluble, coagulable, and mono-amino- and amido-nitrogen increased as the tubers matured. The proportion of tubers to green vines appeared to be higher for sprayed than unsprayed plants.

Average data for seven States obtained in 1919 showed the food value of copper-sprayed potatoes to be equivalent to a yield of 839 lb. per acre more than that for those unsprayed. Two factors, increased yield (48 bushels per acre) and an increase of solids (5·6 per cent.), are involved.

Some results obtained at Arlington Experimental Farm, Virginia, comparing a 10-10-50 with a 5-5-50 Bordeaux, indicate that the former spray has no advantage over the latter, and may possibly furnish an excess of copper for the maximum stimulating or protective effect. Results from New Jersey, where a 4-4-50 Bordeaux spray was applied eight times, compared with results from only four applications of the same mixture, show that the tubers were lower in solids in the former than in the latter case. This again suggests that an excess of copper, in the absence of late blight (*Phytophthora infestans*), mitigates the stimulatory action of the spray.

Tubers from several varieties of potatoes grown in the north were higher in solids than tubers of the same varieties grown in the south.

A larger yield of potatoes was secured from copper-sprayed than from control or non-copper-sprayed vines, the three sprays tried giving essentially the same increase in yield and in solids.

FRANCHINI (G.). **Action des latex végétaux sur différents protozoaires.** [The action of plant latex on various protozoa.]—*Bull. Soc. Path. exot.*, xvi, 4, pp. 256–263, 1923.

The results of further experiments on the action of plant latex on various trypanosomes and other protozoa [see this *Review*, ii, pp. 229, 230] showed that trypanosomes of human origin maintained their vitality longest in the latex of different species of Euphorbiaceae, Asclepiadaceae, Apocynaceae, Artocarpaceae, and Urticaceae. Whereas the latex of certain plants, e.g., *Asclepias curassavica*, *Gomphocarpus fruticosus*, and an undetermined species of *Euphorbia* rapidly produced a fatal effect on the protozoa [excluding trypanosomes], that of *Tanghinia venenifera* (Apocynaceae), which inhibits the development of bacteria, conserved their vitality. The trypanosomes lived longer in the latex of any of the plants used than in the physiological or citrated solutions.

Crithidia melophagi and *C. gerridis* were more resistant to the action of the latex than most of the trypanosomes. The vegetative forms of the amoebae of human dysentery, *Lamblia* (*Giardia*) *hominis*, *L. muris*, *Trichomonas hominis*, *T. muris*, *Cercomonas hominis*, *Hexamitus muris*, and *Tetramitus muris* rapidly succumbed to the action of the latex, but living encysted forms were found several months after the inception of the cultures, those of human *Lamblia* being the most resistant.

During the progress of the experiments it was observed that the

latex of certain plants exercised a remarkable preservative action on the bacterial flora of the human intestinal tract. Such latex, even in a very diluted form, would probably be a valuable substitute for bouillon and other culture media.

NAKATA (K.), NAKAJIMA (T.), & TAKIMOTO (S.). **Studies on Sugar beet diseases and their control.**—*Bull. Agric. Exper. Stat. Chosen*, vi, pp. 1–118, 8 pl., 1922. [Abs. in *Japanese Journ. of Bot.*, i, 3, p. 43, 1923.]

Since 1913 the writers have made a special study of the diseases of sugar beet and their control in Korea. These include leaf spot (*Cercospora beticola*), snake-eye disease (*Phoma betae*), sclerotial disease (*Sclerotium rolfsii*), bacterial leaf spot (*Bacterium aptatum*), crown gall (*Bacterium tumefaciens*), 'Mompa' disease (*Septobasidium mompa*), stem and root rot (*Corticium vagum* [*solani*]), *Alternaria* leaf spot (*Alternaria* sp.), white rot (*Bacterium destructans*), black heart leaf spot (probably *Colletotrichum omnivorum*), white hollowed disease (*Rhizoctonia* sp.), and *Physarum* disease (*P. cinereum*).

The most serious of these diseases is leaf spot, which causes 20 per cent. loss of yield and 40 per cent. loss of sugar content. The causal organism, *C. beticola*, remains viable for 16 months at room temperature, for 5 months on the surface of the field, and for 8 months in the soil under winter conditions at Suwon (southern Korea). The sclerotium-like bodies embedded in the host tissue play the chief part in overwintering. The disease may be controlled by spraying and seed disinfection.

The disease of leaves and roots caused by *Phoma betae* ranks next to leaf spot in severity and is prevalent in sandy soil or during dry seasons. The causal organism is disseminated on the seed and the spores retain their vitality even after passing through the alimentary canal of live stock. Seed treatment and rotation of crops are effective in controlling the disease. *Corticium vagum* affects the stems, roots, and leaves of the plants and may remain viable for six months in the soil of Suwon. The removal of soil round the crown of the roots to facilitate aeration, and sterilization of the soil with formalin are recommended.

Sclerotium rolfsii is widely spread throughout all regions of Korea.

BRUNER (S. C.). **Mosaic and other Cane diseases and pests in Cuba.**—*Louisiana Planter*, lxx, 22, pp. 452–455, 4 figs., 1923.

The symptoms of mosaic disease of sugar-cane are briefly described and Brandes' report of its transmission by *Aphis maidis* [see this *Review*, ii, p. 381] confirmed as a result of the writer's experiments in Cuba.

Generally speaking, very few systematic efforts are being made to control the disease in Cuba, with the result that it is steadily increasing, though less rapidly than in Porto Rico. Although infection can be considerably reduced, when the percentage is not too high, by the destruction of the diseased plants in a given field, the method ultimately adopted in Cuba will probably be the use of resistant and immune varieties. Under Cuban conditions the

Crystalina variety is highly resistant, although reports (not yet verified) from Oriente state that the variety is heavily attacked. Preliminary experiments with this variety carried out on the typical red soil at the Experiment Station have shown that under conditions where Yellow Caledonia, Morada, and Blanca varieties break down severely and develop large cankers and stunted stalks, the Crystalina variety bears practically no cankers during the first year's growth and there was no noticeable difference in the size or appearance of healthy and infected stools, except for the mottled condition of the leaves. An occasional stalk of diseased Crystalina was found, showing a few very superficial white cankers, so that possibly, under certain conditions, the variety may be more susceptible than is usually the case.

In Central Soledad, where the disease was first observed in Cuba, it is spreading very slowly and, according to a report dated May 1923, causing no appreciable damage.

The highly resistant Hawaiian variety, Badila, has been introduced into Cuba, where it is giving excellent results. It compares favourably with Crystalina in purity and in the percentage of glucose and sucrose. It is being propagated at the Experiment Station for distribution on a large scale.

Excellent yields have been obtained from the immune Kavangire or Uba cane, amounting in Porto Rico to 81 tons per acre. In the Argentine an average of seven crops of Uba cane is reported to have yielded 3½ times the tonnage of the ordinary Cinta or Rayada and three times the quantity of sugar per acre. In Cuba the highest yield in 1921 was 58·6 tons of cane and 8·54 tons of sugar per acre. This refers to cane grown without irrigation or fertilizers. The standard of purity in certain lots of the present year's crop was also extremely high, (91·92) [quotient of purity]. Uba is especially valuable for planting in poor, exhausted soils where Crystalina often has to be abandoned owing to its liability to deteriorate under unsuitable conditions. Since 1919 cuttings of Uba cane have been distributed to more than 230 agencies and individuals.

Other diseases of sugar-cane are of minor importance in Cuba. Root rot, attributed to *Marasmius sacchari* and *M. stenophyllus*, and black rot, caused by *Melanconium sacchari*, principally attack injured or weakened canes. The latter fungus may also cause considerable damage to over-ripe cane. Red rind disease (*Colletotrichum falcatum*) and various leaf spot diseases due to *Leptosphaeria sacchari*, *Helminthosporium sacchari*, *Cercospora vaginae*, and *C. kopkei* are common but not destructive, while *Diplodia cacaoicola* [*Botryodiplodia theobromae*], *Thielaviopsis paradoxa*, *Hypochnus sacchari*, and *Sclerotium rolfsii* are relatively innocuous.

EARLE (F. S.). **Experiences with mosaic disease. Uba found to be immune in Cuba.**—*South African Sugar Journ.*, vii, 5, pp. 427-428, 1923.

During a recent visit to Cuba the writer was greatly impressed by the rapid spread of mosaic disease of sugar-cane in the island. Some fields in the Pinar del Rio province are infected to the extent of 50 per cent., while in the Guantanamo district the disease is also extremely severe. The yield in the latter locality has declined

by one half since last year, partly on account of the drought, but also owing to the epidemic of mosaic. In spite of the wide publicity given to the Porto Rico experiments in the control of the disease [see this *Review*, i, p. 342 and also ii, pp. 88, 241], no concerted plan for the adoption of similar measures has been organized in Cuba, where the situation is becoming increasingly serious.

Uba, Zwinga, Cayania 10, and some of the slender North Indian varieties are immune from mosaic disease, and Crystalina is resistant. With the last-named variety the losses from mosaic under ordinary Cuban conditions vary between 20 and 50 per cent. Good cultivation and the liberal application of nitrogenous fertilizers, together with a plentiful rainfall, may keep the percentage of infection down to the lower figure. Infected fields cannot be kept in production for nearly so long a period as healthy ones, and this strikes at the root of Cuba's great advantage over most other cane-growing countries—the capacity to produce many ratoon crops without the expense of replanting the fields.

The use of healthy 'seed' and the roguing of partially infected fields (where the incidence of disease does not exceed 25 to 30 per cent.) will do much to prevent the spread of mosaic.

KUYPER (J.). **Het Wortelrot op Java, speciaal in verband met de Rietsoort EK 28.** [Root rot in Java, especially in connexion with the Cane variety EK 28.]—*Meded. Proefstat. Java Suikerind.*, 4, pp. 117-161, 2 diag., 1923.

Towards the end of 1921 root rot of sugar-cane was observed to be causing considerable damage in Java, especially on the variety EK 28.

The roots of affected plants were frequently stunted, crooked, or swollen, the shoots small and sickly, and the leaves yellow, crinkled, and covered with irregular withered spots. Sections through the base of the diseased shoots revealed grey, red, or reddish-brown discoloration of the tissues, which were slightly spongy in texture and sometimes dead. The growing points were more vividly coloured than those of healthy cane and the buds had a tendency to run out.

The etiology of the disease is still rather obscure. There appear to be two distinct kinds of root rot; the so-called 'anaerobic' root rot, which occurs chiefly on heavy, badly aerated soils saturated with stagnant water, and 'dry' root rot, which is primarily an affection of the setts, due to an insufficiency of water in the soil.

There is no evidence of a parasite being implicated, and whilst the similarity of the disease to grey speck of oats [see this *Review*, i, p. 417 and ii, p. 403] suggests that soil alkalinity may be the cause, experiments on this point have not yet been carried out.

Biennial rotation greatly increases the incidence of root rot; at least three years should elapse between one crop of sugar-cane and the next.

Exhaustive evidence is adduced to prove that there has been no increase in the percentage incidence of root disease in Java. EK 28 has been susceptible from the very first, but even allowing for a certain amount of disease it shows no sign of 'degeneration' and

there can be no justification for a reduction of the area under this prolific and valuable variety.

BERTUS (L. S.). **Grey blight of Tea and Coco-nut: a comparative study.** *Trop. Agric.*, lx, 2, pp. 109–112, 3 pl., 1923.

A study of the *Pestalozzia* spp. causing grey blight of tea and coco-nut leaves was made to ascertain the identity of the species affecting each host [see this *Review* i, p. 413]. Typical *Pestalozzia* spores on tea and coco-nut are fusiform, divided by four septa into a row of five cells of which the three central are light brown and the terminal hyaline. The apical hyaline cell is crested with one to four hyaline cilia and to the lower hyaline cell is usually attached the stalk on which the spore is borne. Abnormalities occur in the dimensions of the spores and in the number of coloured cells.

The species of *Pestalozzia* occurring on coco-nut was cultured on maize meal, French bean, and quaker oats agar. In all three media the chief feature of growth was the aggregation of the hyphae into white, later pinkish tufts, from the centre of which arose black pustules of spores. In the French bean and oatmeal media a stroma was formed, while in the maize meal a pseudostroma was present. The spores originated in distinct pycnidia of diverse shapes and sizes, consisting of a yellowish, pseudoparenchymatous wall, with no ostiole, the spores being liberated by a rupture of the wall at any point. They occurred singly or in groups, but a few spherical pycnidia were found embedded in the stroma or pseudostroma. The average dimensions of the spores on leaves in nature are 20·2 by 5·7 μ; on French bean agar 18·7 by 5·4 μ; on oatmeal 18·8 by 5·5 μ and on maize meal 18·5 by 5·7 μ respectively. The cilia were generally 2 to 5 μ in length, occasionally 10 to 12 μ; the stalk, when present, 1 to 3 μ, rarely 4 to 5 μ. In culture the cilia are shorter than in nature, and do not bear knobs at their ends.

Spores of the *Pestalozzia* found on tea were grown on the same media as above. A rich, flocculent growth of aerial hyphae ultimately developed into a thick, heavy, compact felt, spread over the medium, no tufts of hyphae being formed. A characteristic feature was the production of spores on loose hyphae. The growths on three different media are described in detail, a stroma or pseudostroma being formed on which pycnidia were mainly found. The latter varied in shape and dimensions and were enclosed by a pseudoparenchymatous wall, from which the spores were liberated at any part, but frequently the rupture occurred at the base. The average dimensions of the spores on tea leaves in nature are 25·6 by 6 to 7 μ; on French bean agar 27·3 by 6·7 μ; on oatmeal 27·4 by 6·9 μ, and on maize 26·6 by 6·8 μ. On all the media the cilia, which varied in number between two and four, were very long (up to 40 μ), and mostly knobbed. The length of the stalk varied from 3 to 10 μ.

The morphological and cultural differences between the two species are considered to justify the retention of the distinction which obtains at present. The Ceylon species on the coco-nut leaf is *Pestalozzia palmarum* Cooke and that on tea *P. theae* Sawada.

GARD (M.). **L'apoplexie de la Vigne. Les moyens de la combattre et d'y remédier.** [Apoplexy of the Vine. The means of controlling and curing it.]—*Rev. de Vitic.*, lviii, 1509, pp. 399–401, 1923.

Apoplexy of the vine [caused by the fungus *Fomes igniarius*: see this *Review*, i, p. 416, and ii, p. 437] may be effectually controlled by the application, during the winter, of arsenite of soda made up of 30 kg. carbonate of soda and 30 kg. of arsenious acid, dissolved in 60 l. of boiling water. Between 90 and 100 vines can be treated with 10 l. of the solution at an average cost of 1 to 1·5 fr. [about 3d. to 4½d.], exclusive of the price of labour. The vines may either be sprayed or painted with the solution.

Directions are also given for the excision of the diseased parts and for a special system of grafting to be practised on infected vines.

MCGINTY (R. A.). **Head Lettuce in Colorado.**—*Colorado Agric. Exper. Stat. Bull.* 283, 26 pp., 7 figs., 2 diag., 1923.

The most serious disease of lettuce in Colorado is tip burn, which causes a blackening of the edges of the inner leaves and the partial or total decay of the interior of the head. The disease appears to be of a physiological nature, and in the Imperial Valley it is correlated with excessive alkalinity of the soil. It is most prevalent when bright, hot weather succeeds a rainy period, and soils with an inadequate water supply are more favourable to the disease than those of high water-holding capacity. During storage or transit a slimy soft rot will often start in the tissues weakened by tip burn, causing total loss of the affected head. Even slightly diseased heads invariably develop a disagreeable bitter flavour.

The best remedies for tip burn are good seed and strict attention to cultural measures, with frequent light irrigations during hot, dry spells. Attempts to develop a resistant strain of lettuce are in progress.

The Uganda Customs (Amalgamation) Ordinance, 1918, Notices 5th May, 1923.—*Official Gazette, Entebbe*, p. 294, 15th May, 1923.

The importation into Uganda of sugar-cane plants or parts thereof, except under a written permit previously obtained from the Director of Agriculture, is prohibited.

Amendments to the Regulations under the Destructive Insect and Pest Act.—*Canada Dept. Agric. Exper. Farms Branch Div. Bot.*, 2 pp., 1923.

Amendment No. 26 (No. 3 of 1923) to the Regulations prohibiting the importation of certain species of *Berberis* into Canada provides for the addition of European buckthorn (*Rhamnus cathartica*) to the list of prohibited plants on account of its being a host of the crown rust of oats [*Puccinia coronata*].

Amendment No. 21 (No. 4 of 1923) provides for the addition of *R. cathartica* to the list of plants excluded from admission to the Prairie Provinces (Manitoba, Saskatchewan, and Alberta), and for its extermination, without compensation, within the aforesaid Provinces.